UNIT 2: "*Mni Wiconi*"- WATER IS LIFE

"We are water – we come from water and when the water is sick – we are sick."
--Autumn Peltier, 18, Environmental Activist, Addressing the United Nations

One of the greatest paradoxes of human civilization is that 75% of the surface of our planet is covered in water, and yet, some 2.2 billion people around the world still lack access to safely managed drinking water. By managing our water **sustainably,** we are also able to better manage energy and food production and contribute to goals for decent work and economic growth. Moreover, we can preserve our water ecosystems, their biodiversity, and take action on climate change.

Ocean Literacy **Essential Principle #1:**

"The Earth has one big ocean with many features"

3 Fundamental Concepts that explain **Principle #1**:

1E. Most of Earth's **water (97%)** is in the ocean. Seawater has unique properties. It is salty, its freezing point is slightly lower than fresh water, its density is slightly higher, its electrical conductivity is much higher, and it is slightly basic. Balance of pH is vital for the health of marine ecosystems, and important in controlling the rate at which the ocean will absorb and buffer changes in atmospheric carbon dioxide.

1F. The ocean is an integral part of the **water cycle** and is connected to all of Earth's water reservoirs via evaporation and precipitation processes.

1H. Although the ocean is large, it is finite, and **resources** are limited.

ACTIVITY 2.1— Fundamental Concepts

There is a lot more going on in the ocean besides the fish and coral reefs.

Review the three *Fundamental Concepts of Ocean Literacy* that are listed above.

- 1E refers to the water,
- 1F refers to the water cycle, and
- 1H refers to the limited resources of the ocean.

Explain what each of these Fundamental Concepts mean.

ACTIVITY 2.2— The Water Cycle

> 1F. The ocean is an integral part of the **water cycle** and is connected to all of Earth's water reservoirs via evaporation and precipitation processes.

You don't have to be a science major to teach these *Fundamental Concepts of Ocean Literacy.* There are so many excellent resources that are available to help you design a good lesson plan and to introduce students to key principles of ocean literacy, like "the water cycle."

Resource:

The National Oceanic and Atmospheric Administration (NOAA) provides excellent resources to help demystify and understand and basic principles of the water, the oceans, climate and weather. Here is an excellent explanation of the WATER CYCLE.

ACTIVITY 2.3— Properties of Ocean Water

> 1E. Most of Earth's **water (97%)** is in the ocean. Seawater has unique properties. It is salty, its freezing point is slightly lower than fresh water, its density is slightly higher, its electrical conductivity is much higher, and it is slightly basic. Balance of pH is vital for the health of

marine ecosystems, and important in controlling the rate at which the ocean will absorb and buffer changes in atmospheric carbon dioxide.

Review Fundamental Concept 1E, line by line:

• *Most of Earth's **water (97%)** is in the ocean.* (And it's not all on the surface.)

Discuss

• Tech Insider: Just How Deep Does the Ocean Go?
• Nautilus Live: How much water is in the ocean?…and 20 other fun facts!

Demonstrate each of the *properties of ocean water* that are listed below:

• It is **salty**

• Its **freezing point** is slightly lower than fresh water

• Its **density** is slightly higher

• Its electrical **conductivity** is much higher

• It is slightly **basic**.

• The PH balance of ocean water is *"vital for the health of marine ecosystems, and important in controlling the rate at which the ocean will absorb and buffer changes in atmospheric carbon dioxide."*

• When the PH balance is disrupted, it can lead to a condition called "*acidification."*

Learn more about **ocean acidification** here:

📖 **Resource:**

• **NRDC:** What you need to know about ocean acidification
• **The Ocean Foundation**: International Ocean Acidification Initiative
• **The Nippon Foundation Video:** Ocean Acidification and Climate Change: "The Threat Bubbling Up"

Jump ahead to ***Activity 7.3*** for more on *acidification*.

But Wait! There is still one more significant characteristic of ocean water. One that makes the ocean such a dangerous and unpredictable world:

It is **heavy!**

At sea level, the air that surrounds us presses down on our bodies at 14.7 pounds per square inch. You don't feel it because the fluids in your body are pushing outward with the same force.

Dive down into the ocean even a few feet, though, and a noticeable change occurs. You can feel an increase of pressure on your eardrums. This is due to an increase in hydrostatic pressure, the force per unit area exerted by a liquid on an object.

The deeper you go under the sea, the greater the pressure of the water pushing down on you. For every 33 feet you dive down, the pressure increases by "one atmosphere"…or 14.7 psi. So at 100 feet, (3 atmospheres), the pressure on the human body is roughly 44 pounds pers square inch.

Titan:

In June of 2023, the world was transfixed by a small submarine on a mission to visit the site of the sunken *Titanic,* 12,400 feet below the surface of the North Atlantic Ocean. The 5-member crew ceased communications, one hour and 45 minutes into the voyage. When they could not contact them, the mother ship on the surface called for help. For the next four days a multi-national effort was made, led by the US Coast Guard, to find the vessel and bring them safely to the surface. But it was not to be. The Titan had imploded at a depth of 35 atmospheres or 5,500 pounds per square inch of pressure on the ship. The crew was killed instantly. It was a sad reminder of the terrible beauty of the ocean.

Critical Thinking:

• Research this story a little further. What did investigators conclude were the causes of this tragedy?

• Two of the passengers were tourists who paid $250,000 a piece to participate in the voyage. Do you have any thoughts about people paying for such dangerous adventures?

• To many people, *The Titanic* shipwreck is a hallowed burial site. Should we monetize these kinds of missions? What can scientists learn from visiting the *Titanic*? What can they learn about the *Titan*?

• What does this lesson about water pressures in the ocean mean for our ultimate task of someday building an underwater city?

📖 **Resource:**

• **Scientific American:** See How Crushing Pressures Increase in the Ocean's Depths
• **NOAA:** How Does Pressure Change with Ocean Depth?
• **Boat Safe:** How Water Pressure Works

ACTIVITY 2.4— The Ocean is Huge…(but it is not Infinite!)

1H. Although the ocean is large, it is finite, and **resources** are limited.

The ocean is finite. This is important for every person on the planet to understand.

• Do you agree? If so… why?

Discuss: In the context of our oceans-- what is the meaning of the term finite?

• Just how large is the ocean?

Examine these "Fast Facts" offered by the National Oceanic and Atmospheric Administration. What information here is most surprising? With such large numbers, how can we truly understand the vastness of our oceans?

• How can we begin to comprehend how much a trillion is?

Fast Facts

- A cubic mile of water equals more than one trillion gallons.
- Each day, 280 cubic miles (450 cubic km) of water evaporate or transpire into the atmosphere.
- If all the water in the atmosphere fell as precipitation at once, the Earth would be covered with only about 1 inch (2.5 cm) of water.
- The 48 contiguous United States receives a total volume of about 4 cubic miles (6.4 cubic km) of precipitation each day.
- If all of the world's water was poured on the United States, it would cover the land to a depth of 107 miles (145 km).
- Yet, the ocean is so vast that if the earth were a smooth shell, the ocean would cover the planet the depth of which would be 8,200 ft. (2,500 m).

• If the ocean covered the entire earth, the surface would be 8,200 feet deep!

How deep is 8,200 feet?

Take a Field trip to the tallest building in your community. In San Diego, that would be the *One American Plaza* building on Broadway, which is 500' tall. Stand at that base of *One American Plaza* and look up. Take the elevator to the top floor and look out over the city. Look how far you can see in the distance.

Imagine… it would take 16 *One American Plaza* buildings, stacked on top of each other, to reach a height of 8,200 feet!

ACTIVITY 2.5— Water Scarcity

In the *Rime of the Ancient Mariner,* Samuel Taylor Coleridge wrote the famous line: "Water, water everywhere, and not a drop to drink."

Discussion:

• What do you think Coleridge meant? What was the context of this line?
• This poem was written in 1798, but notice how often the sentiment is used when talking about drinkable water.
• Think about this: 70% of the planet is covered by water

…but only 2.5% is actually fresh water that is drinkable…
…and of that… only 1% is accessible.

• Water comes out of our taps as soon as we turn the spigot on. There is also an abundance of bottled water in all of our grocery stores. So where is there a scarcity of water?
• Where does fresh water come from for California? Who supplies water for the City of San Diego?

Read: Water Scarcity in the World

Research: *Is it true that there is "another ocean" locked inside the Earth? If so, is it the answer to our problem of water scarcity?*

📖 **Resource:**

- **Smithsonian:** Is There an Ocean Below your Feet?
- **IFL Science:** There is a Massive Ocean of Water Beneath Our Feet
- **NPR:** Deep Underground, Oceans of Water May be Trapped In A Crystal Sponge
- **Brookhaven National Laboratory:** New Evidence for Oceans of Water Deep Beneath the Earth
- **Hakai Magazine:** How the Oceans inside the Mantle Affect the Habitability of the Earth
- **New Scientist:** Massive Ocean Discovered towards the Earth's Core
- **En-Vols:** Scientists Have Discovered an Ocean Under the Surface of the Earth
- Indy100: Massive Ocean Discovered Beneath the Earth's Crust Containing More Water than on the Surface
- **EarthSky**: Scientists Believe a Hidden "Ocean" Lies Deep Within the Earth
- **You Tube:** A Massive Ocean Under Our Feet?

ACTIVITY 2.6— United Nations GOAL #6

The United Nations Sustainable Development Goal #6 is to *"Ensure access to water and sanitation for all."*

Discuss:

• Why is access to water, sanitation and hygiene considered to be a human right?
• Why is it a sustainability goal?

• 75% of the planet's surface is water. What is preventing us from achieving this goal?
• How will we know if we achieve the goal?
• How does desalination work? How much energy is required to convert ocean water to drinking water?

Jump Ahead to *Activity 2.7* and learn more about the process of desalination.

• How do water reclamation plants make dirty water reusable?

Visit the United Nations website to gather data that reenforces the importance of achieving Goal #6.

📖 **Resource:**

• **United Nations: "Why it Matters"**

Invite a speaker in from the San Diego Water Authority to talk about what they are doing to make clean water available to everyone in our community. Ask them to talk about promising global initiatives to close the gap.

Discuss:

This Unit begins with a quote by a young, activist named Autumn Peltier, a member of the Anishinabek Nation in Ontario, Canada.

"We are water – we come from water and when the water is sick – we are sick."
--Autumn Peltier, 18, Environmental Activist, Addressing the United Nations

Critical Thinking:

Does the San Diego Water Authority revere the water as a *sacred* resource in the way that Autumn Peltier does? What's the difference? Does it matter?

ACTIVITY 2.7— The 8 Scientific Practices: *Investigations*

Number 3 of the "8 Scientific Practices" used by scientists, teachers, and students is **Planning and Carrying out Investigations:**

Scientists and engineers plan and carry out investigations to answer questions. In these investigations, they identify dependent variables, measure the response in independent variables, collect data and report results.

Investigation: A Desalination Exercise:

San Diego has access to all of the water it could ever need. There is just one problem: human beings can't drink salt water, so the salt will have to be removed through a process of desalination.

Design an investigation in which students measure the levels of salinity in water samples taken from various different water sources, and then extract the salt.

📖 Resource:

Here is a sample desalination project from Education.com. Here is another one: from Sciencing.

Discussion:

• What are your observations and findings?
• Which would be easiest to convert to fresh water? Why?
• How could you take your project to scale?
• How could you ensure investors you use only renewable energy to convert sea water to freshwater?

Critical Thinking:

If desalination is the solution to UN Goal #6, why aren't there desalination plants in every community?

📖 Resource:

San Diego County Video: Carlsbad Desalination Project

ACTIVITY 2.8— Environmental Justice

Environmental justice is the right of all people and communities to equal environmental protection under the law and equal involvement in environmental decision-making processes. It is the right to "live, work, and play in communities that are safe, healthy, and free of life-threatening conditions."

• Find some more definitions of Environmental Justice that make sense to you.
• What does Environmental Justice have to do with water scarcity?

📖 **Resource:**

• **The National Resources Defense Council (NRDC):** "What is Environmental Justice?"

ACTIVITY 2.9— Standing Rock, Over and Over

Research the story behind the 2016 Standing Rock protest.

Critical Thinking:

What was the issue? Why was water at the center of their protest? Why did it attract world-wide attention? Was the protest successful?

Why was Standing Rock such a vivid example of environmental justice?

Some of the most prevalent protest signs at Standing Rock in South Dakota, were emblazoned with a reminder written in the native language of the Sioux:

"Mni Wiconi"

It means *"Water is Life."*

Why did "*Mni Wiconi"* become the battle cry for the Standing Rock protest?

Invite a speaker from Standing Rock to meet with youth leaders in San Diego about water sustainability.

Watch this music video: Stand Up Stand N Rock? What is the message of this song? What images did you hear or see in this video that resonated with you?

One step further:

Research what happened to the water in Flint, Michigan. This crisis was preventable. How is it also an example of environmental justice? What does Flint have in common with Standing Rock?

• Read more about the young Canadian activist Autumn Peltier. What inspires her to speak to world leaders about the sacred aspects of water?

• Why is the title of this Activity; *Standing Rock, Over and Over*?

ACTIVITY 2.10— A Sea of Plastics

The amount of plastic in the ocean is expected to double in the next 15 years, and by 2050 there could be more plastic than fish in the sea (by weight). There are giant plastic islands floating on the ocean surface, and beaches around the world are increasingly littered with plastic rubbish even in the Arctic.

Research the state of plastic pollution in our oceans. You can get a pretty good start here— at Fact Sheet: Plastics in the Ocean posted by EarthDay.Org

Here are some other organizations that research and archive data about plastics and garbage in our oceans:

• Ocean Clean Up

• United Nations

• Eradicate Plastic

• Plastic Oceans

• ReThink Plastic

Critical Thinking:

In their 2016 report to the World Economic Forum, the Ellen Macarthur Foundation estimated that if we do not act, there could be more plastic than fish in our oceans (in weight) by the year 2050.

- Do you think that it is possible that our oceans might some day have more plastic than fish in them?
- Is the Ellen Macarthur Foundation using hyperbole to dramatize their point?
- Does it matter?

Prepare a Presentation to your Peers:

- What is the current state of plastics in the ocean?
- What harm do these plastics do?
- Based on your research, what are some of the solutions that have been implemented, so far, to address the crisis of plastic pollution?
- What are some of your ideas for how to rid the oceans of plastic pollution?
- Deliver your presentation. What are some of the questions your peers have?

📖 Resource:

- **National Geographic Kids: Plastic Pollution**
- **Earthday.Org:** Public School Reliance on Plastic Harms Student's Health and the Environment
- **United Nations Environment Program:** Out Planet is Choking on Plastic
- **The Guardian: More Plastics than Fish in the Sea by 2050**