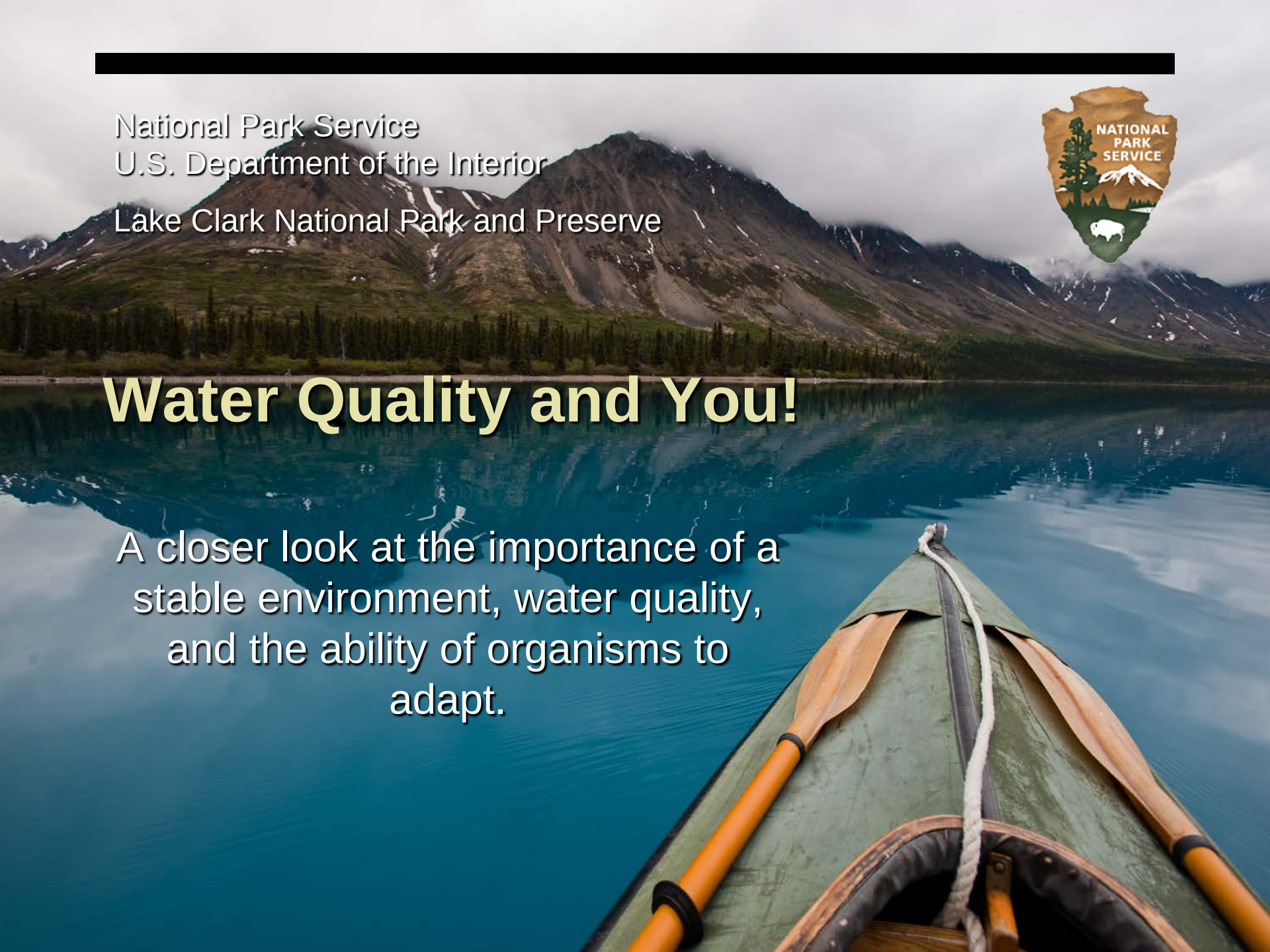
National Park Service
U.S. Department of the Interior

Lake Clark National Park and Preserve

Water Quality and You!

A closer look at the importance of a stable environment, water quality, and the ability of organisms to adapt.



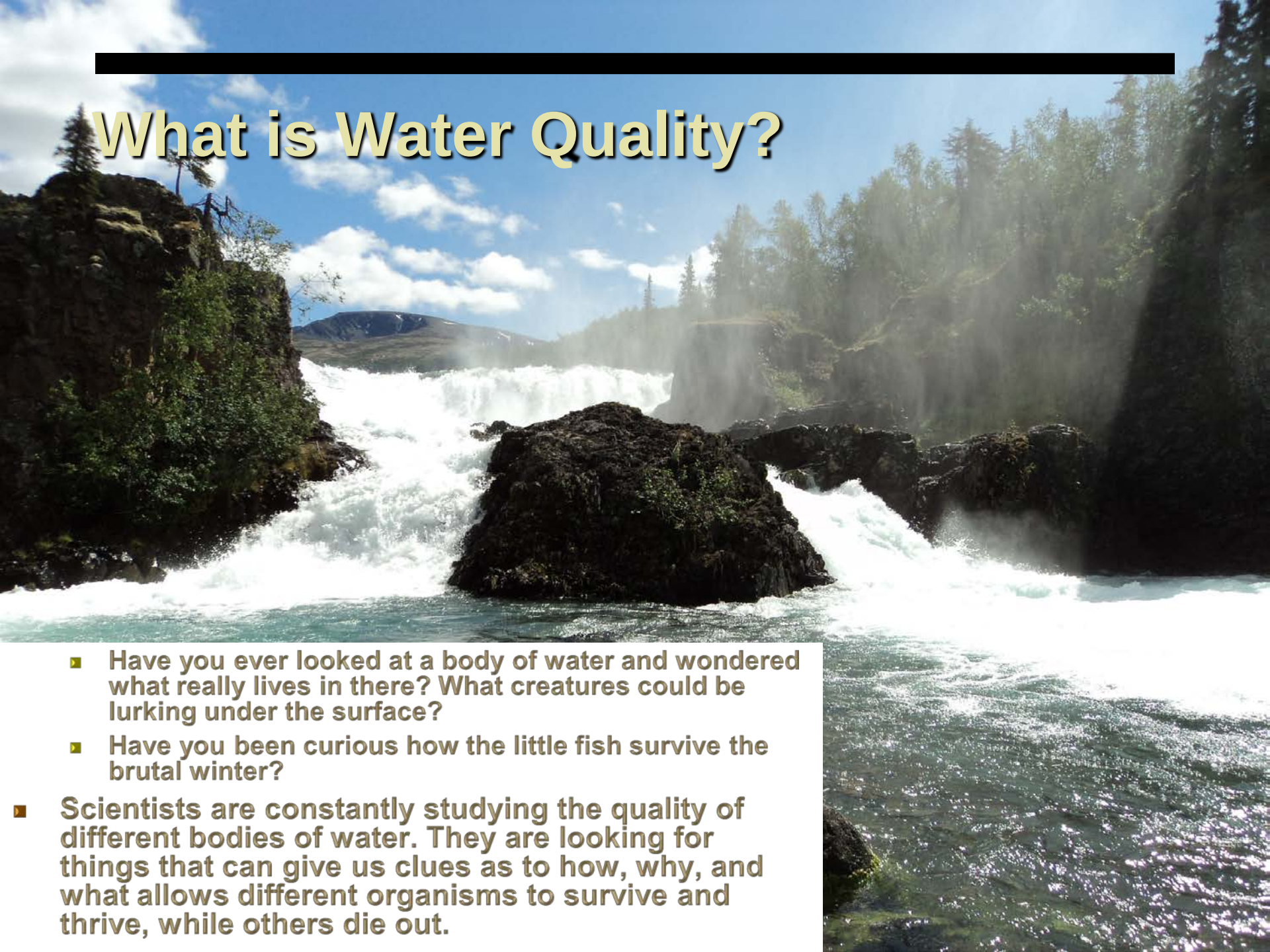
FIRST THINGS FIRST…Standards

- According the NGSS (next generation science standards) this lesson will cover the following standards.
  - HS – LS2 Ecosystems: Interactions, Energy, and Dynamics (HS-LS2-2)
  - HS – ESS2 Earth's Systems (HS-ESS24 and HS-ESS2-5)
  - HS-ETS1 Engineering Design (HS-ETS1-2)

Just a heads up…

- When you see a “Let’s Consider” stop and talk with your neighbor or as a group about the concept and knowledge you already have.
- When you see an underlined link, head over to the website and get more information on the topic!
- Some slides have videos and volume embedded, be sure to have your volume turned up!
- Have fun!

What is Water Quality?



- Have you ever looked at a body of water and wondered what really lives in there? What creatures could be lurking under the surface?
- Have you been curious how the little fish survive the brutal winter?

- Scientists are constantly studying the quality of different bodies of water. They are looking for things that can give us clues as to how, why, and what allows different organisms to survive and thrive, while others die out.

What is Water Quality?

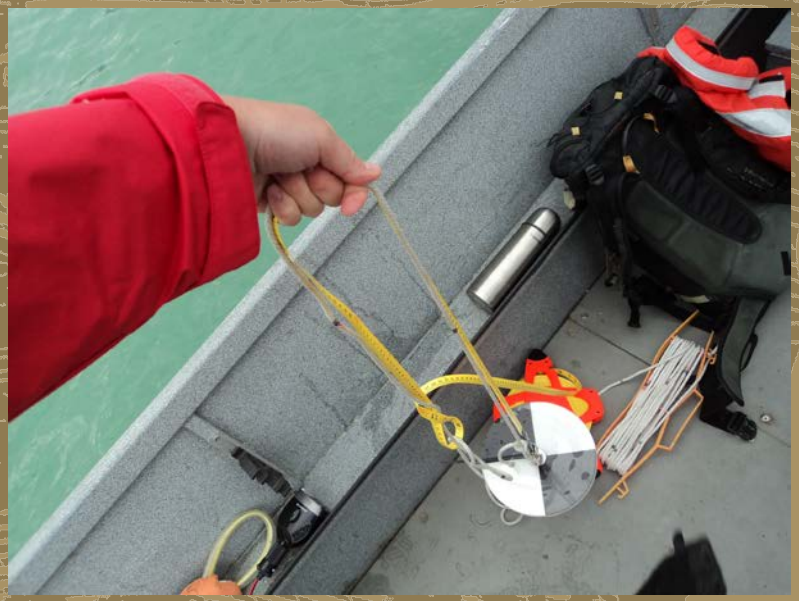
- Water quality is the measure of productivity of a body of water.
  - What does that mean?
- The ability for the body of water to sustain life that is present, or its ability to stay balanced.
  - How do we know?
- Scientists will do a series of test that can be measured based on several physical, biological, or chemical characteristics of the water

What is Water Quality?

- What are the main tests scientists use?
- Many times scientists will use the following “Big Four” tests when measuring water quality and productivity
  - Dissolved oxygen content
  - Turbidity
  - pH
  - Water temperature

What is Water Quality?

Scientists use high tech probes and sensors to measure most things, but will also use things called Secchi disks for turbidity measurements



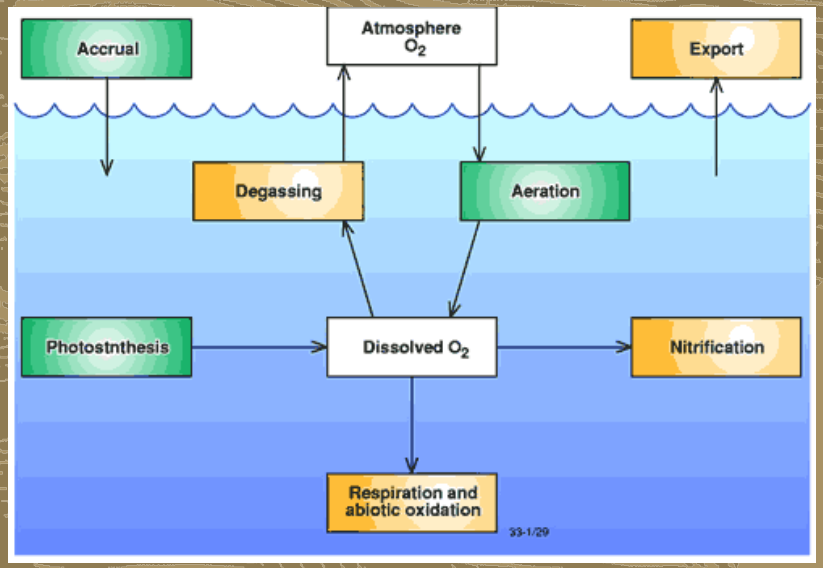
Standard Secchi Disk

SONDE Device with probes and sensors

Dissolved Oxygen

- Dissolved oxygen (DO) is the amount of oxygen present in bodies of water
- Because this dissolved oxygen is used by all forms of aquatic life it can be considered one of the main determinations for productivity of the water
  - Productivity is the health and viability of a body of water (whether it can host life and at what level it can host life)

Dissolved Oxygen



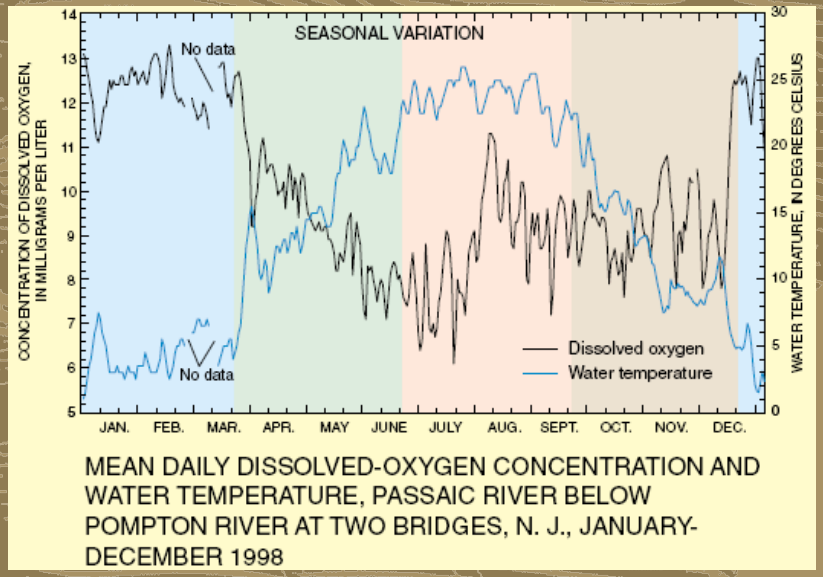
http://www.ozcoasts.gov.auindicatorsdissolved_oxygen.jsp/

- Oxygen can be dissolved in the water by one of two main ways
  - Through the atmosphere
  - Through the ground-water as it comes up through the earth

Dissolved Oxygen

- DO levels can fluctuate based on the season, temperature of water, and photosynthetic rates
  - Photosynthesis will occur when there is a lot of light and warmth hence DO will be lower in areas where there is a high concentration of plant life and warm temperatures
- Warm, stagnant water can cause a lot of issues with aquatic life as well
  - The water near the top of the water is warm – low dissolved oxygen levels
  - The water near the bottom has low levels of oxygen because of depth
- From that we can see a loss of aquatic life because of levels that are not conducive for life

Dissolved Oxygen



MEAN DAILY DISSOLVED-OXYGEN CONCENTRATION AND WATER TEMPERATURE, PASSAIC RIVER BELOW POMPTON RIVER AT TWO BRIDGES, N. J., JANUARY-DECEMBER 1998

- Temperature is inversely related to DO levels
  - The colder temperature water can hold more dissolved oxygen than warmer water
  - Warmer seasons will show a lower amount of DO
    - Please note the graph for representation and understanding
- Areas with a strong glacial input will show a higher dependency on ground water for its DO levels

Want more proof? Check out the studies done at Aialik Bay and Kenai Fjords by SWAN!

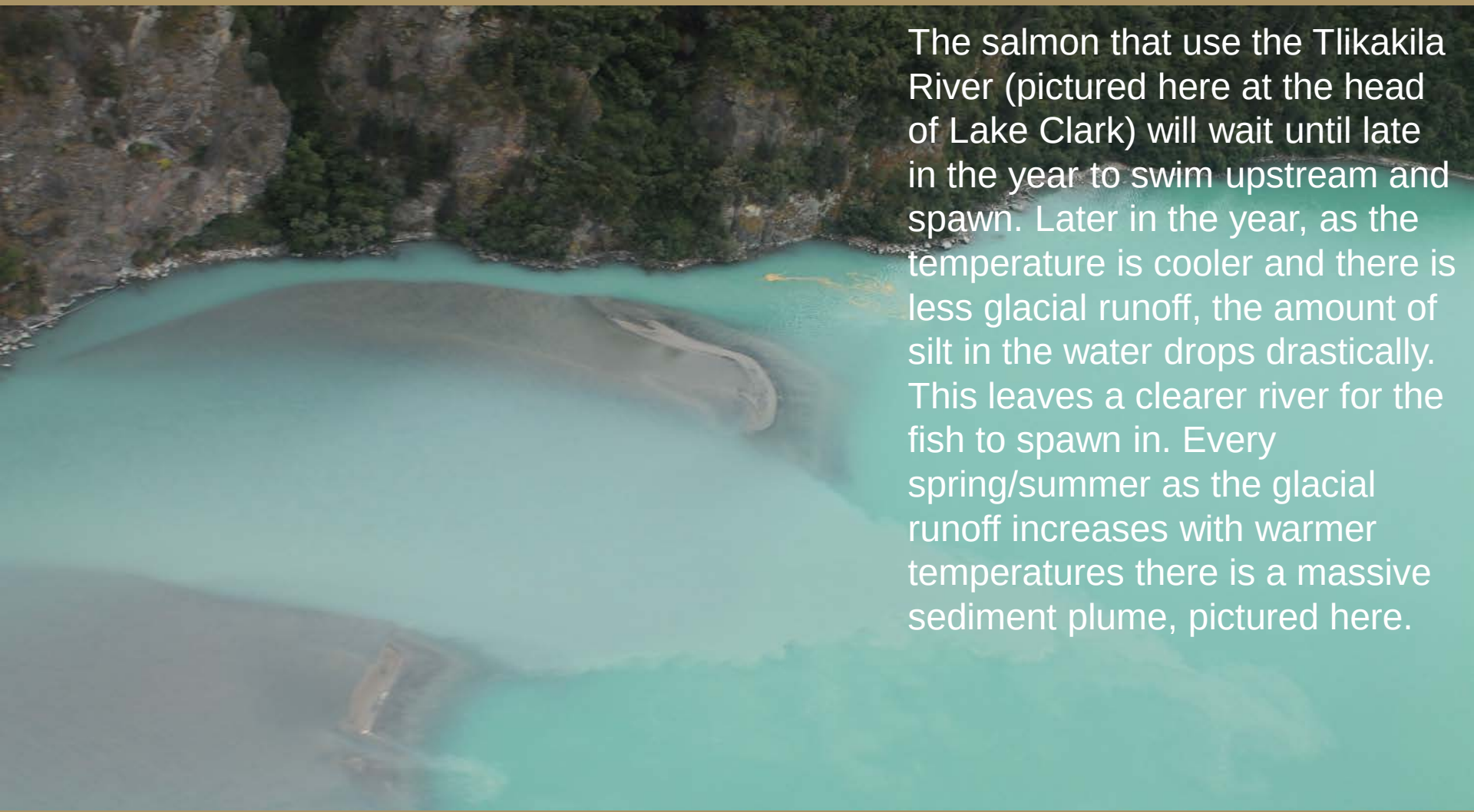
Dissolved Oxygen

- “Let’s Consider”
- In Alaska we are seeing an increased rate of melt in the glaciers surrounding Lake Clark. Lake Clark is the largest lake fully contained within a national park and is home to a variety of fish species including a large amount of sockeye salmon that come in from Bristol Bay. The salmon population is one of the last remaining wild populations in the world. As climate changes, the risk of losing this population becomes eminent
  - How might the increased temperatures be effecting the the amount of dissolved oxygen in the glacial outlets that support Lake Clark? What might the long term effects of this change?

Turbidity

- Turbidity is the measure of water clarity (how easy it is to see through the water)
  - It is the amount of light that is scattered by the different materials (dirt, silt, algae, or other microorganisms) in the water giving it a cloudy effect.
  - The turbidity is measured in NTU's (nephelometric turbidity units) and can range from 0 – clear water on up

Turbidity – "Let's Consider" The image below was taken of Lake Clark in 2012 by SWAN team member Evan Booher. You can clearly see the sediment plume as it mixes with the fresh water. This mixture of fresh water and glacial silt gives Lake Clark it's unique color. The sediment also effects the turbidity of the lake. With an increased turbidity, the fish have a harder time swimming up river to spawn. Why might that be?



The salmon that use the Tlikakila River (pictured here at the head of Lake Clark) will wait until late in the year to swim upstream and spawn. Later in the year, as the temperature is cooler and there is less glacial runoff, the amount of silt in the water drops drastically. This leaves a clearer river for the fish to spawn in. Every spring/summer as the glacial runoff increases with warmer temperatures there is a massive sediment plume, pictured here.

Turbidity

- Increased levels of sediment can hurt an ecosystem
  - Pollution can decrease the amount of light that is able to penetrate the surface of the water killing species or harming the animals
  - Depending on the water temperature, turbid waters can host pathogens and bacteria's which can harm or kill off a population.

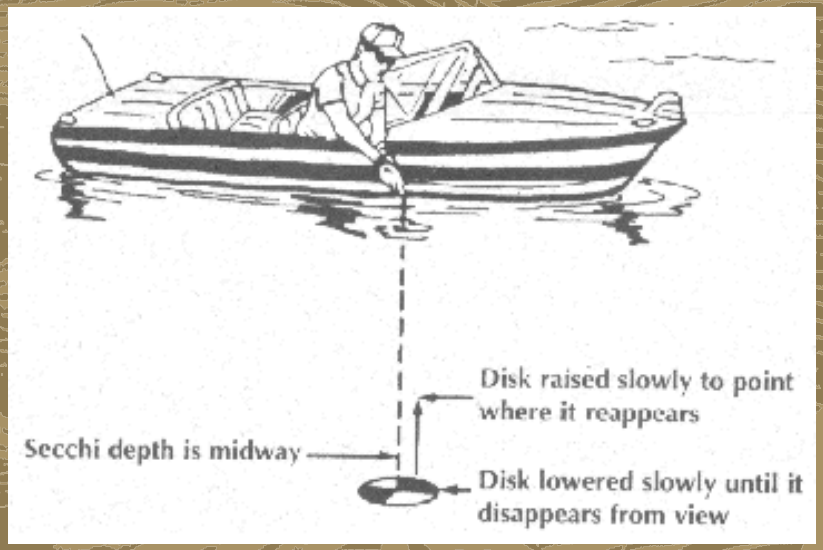
http://www.waterontheweb.orgunderwaterqualityturbidity.html/

Turbidity – how it's measured

- Turbidity is measured by taking a sample of water from the area of study and measuring it against standard vials of water that have been adjusted.
  - The vials are inserted into a machine that sends out a ray of light through the water to measure it against the standard

http://www.globalw.comproductsturb430.html/

Turbidity – how it's measured

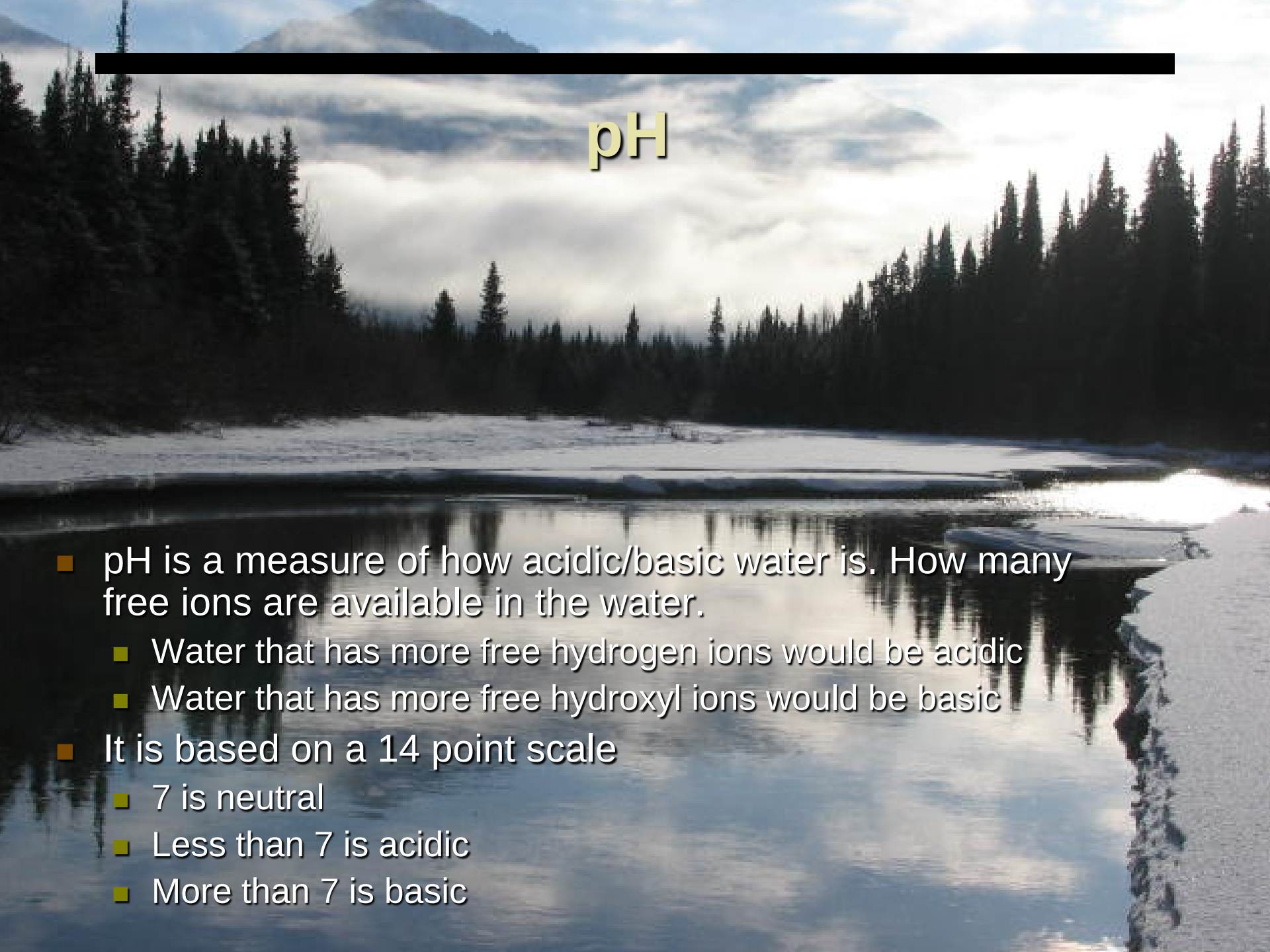


- One can also measure turbidity by using a Secchi Disk
- A Secchi Disk is a circular disk that is divided into quadrants that alternate black and white. The disk is 8 inches in diameter
  - The disk is lowered into the water until it can no longer be seen from the surface
  - When the disk is no longer visible, a measurement is taken and recorded as the lake's turbidity in meters

http://lakes.chebucto.org/DATAPARAMETERSSDsd.html/

Turbidity

- Let's Consider:
  - How might the increasing glacier melt influence turbidity?
  - How might that effect the aquatic life within lakes and rivers?
- Follow the link to the video "350 days in the life of a retreating glacier" by 350.org to watch the video from Youtube about the time lapse of a glacier
  - http://youtu.be/6dFbuaz130c

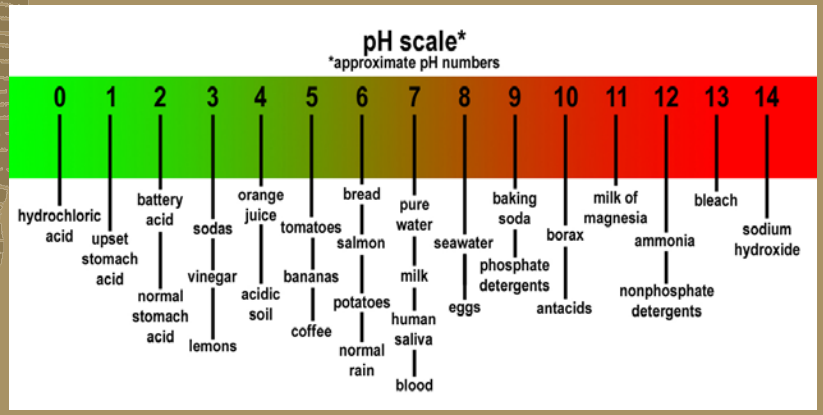


pH

- pH is a measure of how acidic/basic water is. How many free ions are available in the water.
  - Water that has more free hydrogen ions would be acidic
  - Water that has more free hydroxyl ions would be basic
- It is based on a 14 point scale
  - 7 is neutral
  - Less than 7 is acidic
  - More than 7 is basic

pH – What is it good for?

- "The pH of water determines the solubility and biological availability of chemical constituents such as nutrients and heavy metal" (usgs.gov)
  - What that means is that water's ability to dissolve sediment and and provide nutrients for aquatic life is determined based on the things dissolved in the water



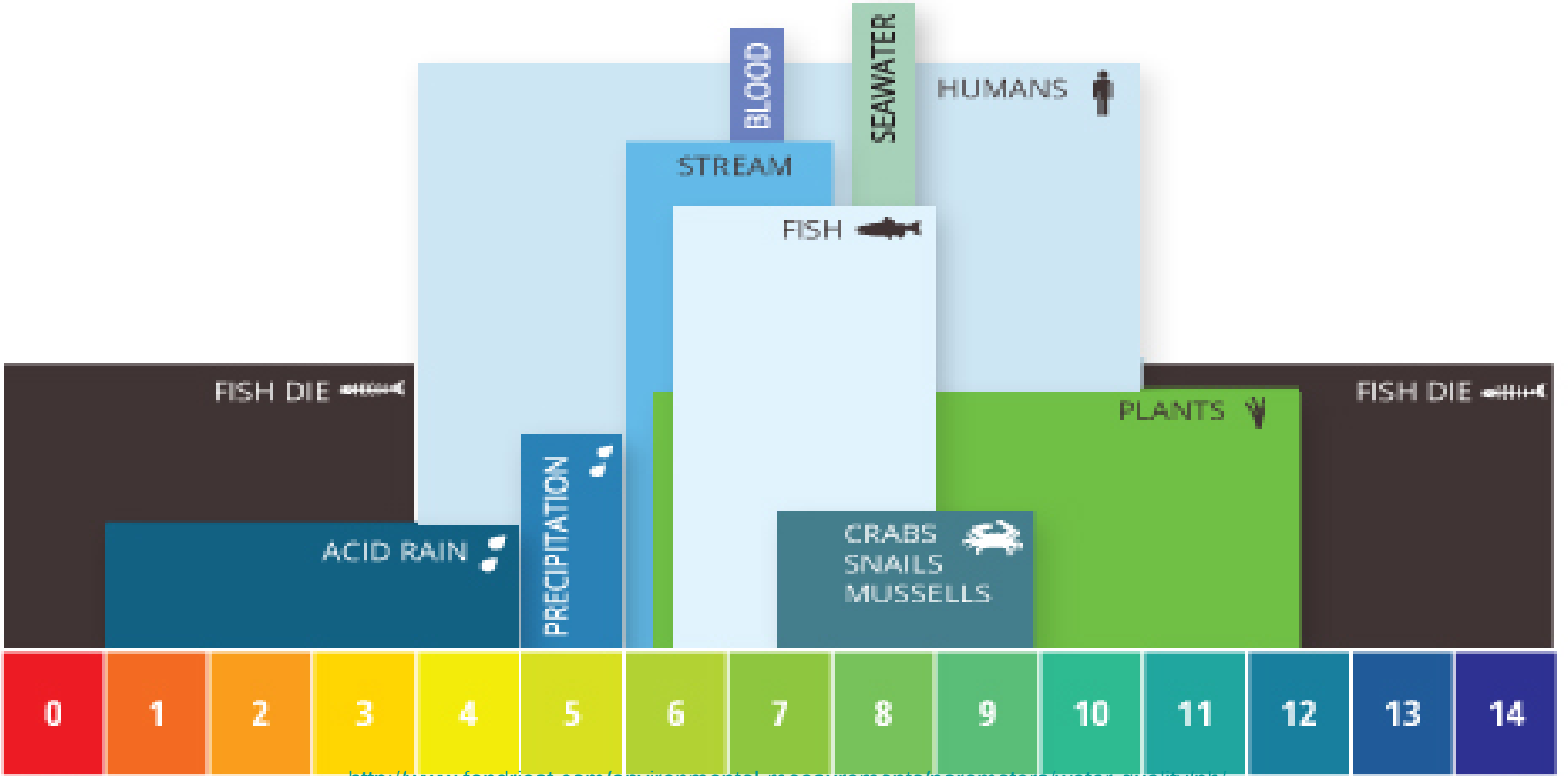
http://getwellstaywellathome.com/blog201203/using-ph-as-a-health-monitor/

pH – What is it good for?

- Water's pH will determine the amount of nutrients in the water like carbon, nitrogen, and phosphorus and if there is enough for the aquatic life to use
  - Nutrients will slightly increase the pH
- It will also determine the amount of heavy metals and if they are at toxic levels
  - Metals will lower the pH

pH – What is it good for?

Let's Consider: Take a look at the graph below about pH. Discuss the importance of a stable pH on the inhabitants of an aquatic ecosystem.



http://www.fondriest.com/environmental-measurements/parameters/water-quality/ph/

Water Temperature

- This test is pretty easy to understand.
  - Throughout the year scientists and technicians use probes to measure the water temperature at different depths to monitor for change
  - When the water temperature is fairly stable, any minor event can cause a drastic change for those animals and plants living there.

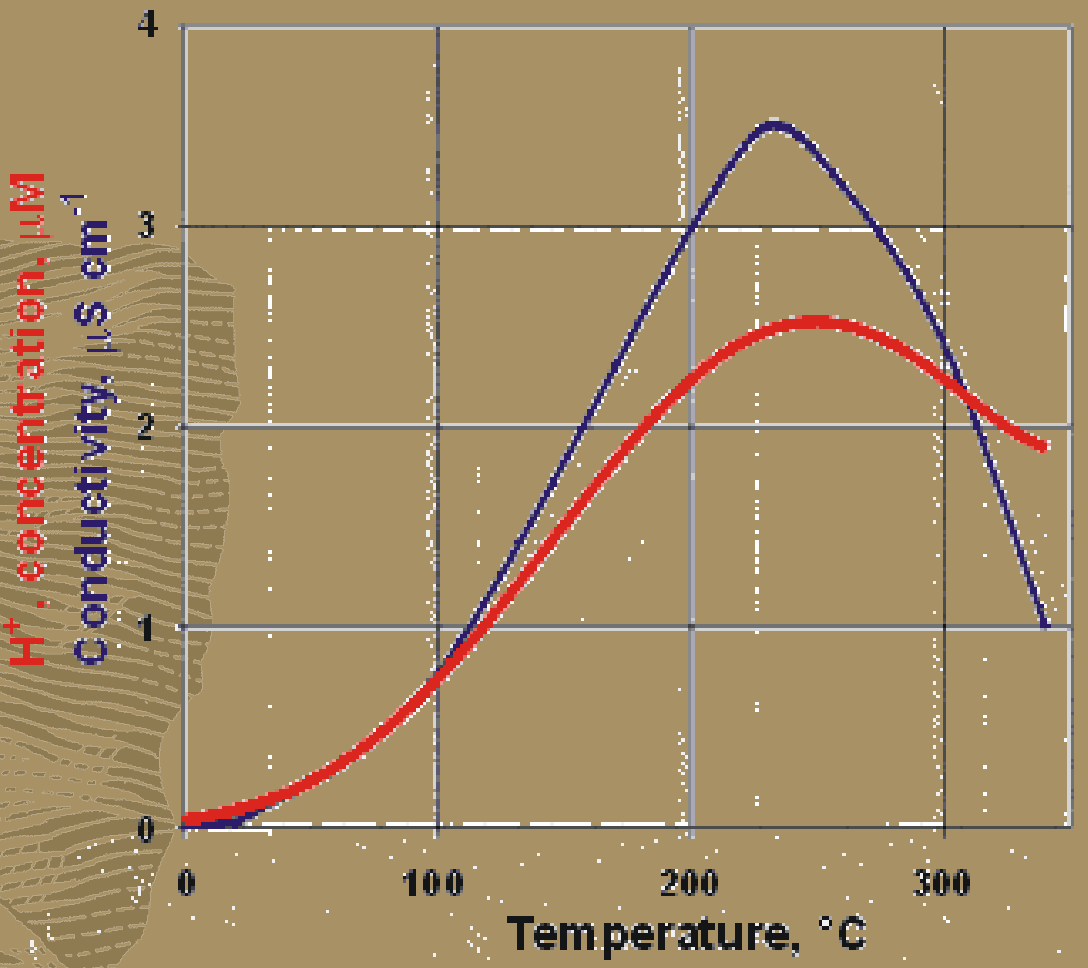
Water Temperature

- Remember, Dissolved Oxygen is adversely effected by water temperature
  - higher temperature = lower DO levels
  - Lower temperature = higher DO levels
- Water temperature can also effect the electrical conductivity of the body of water
  - The rate of chemical reactions tends to be higher in warmer temperatures therefore has a higher electrical conductivity (higher change for electric current to travel through)

Water Temperature

As illustrated by the graph, you can see as the temperature goes up so does the pH and thereby the conductivity.

“Let’s Consider” Take a moment and discuss why there might be a drop off in conductivity around 250ºF



How is water quality monitored?

- In Alaska there is a team of scientists and technicians who are responsible for many of the national parks in the state. The team is known as SWAN.
- They are hired, mainly seasonally, to monitor the lakes and take different measurements
- In different states there are different groups who monitor quality (check your state's EPA or national park website)

Who is SWAN?

- Southwest Alaska Network (SWAN) is a group of scientists and technicians, hired by the National Park Service, who monitor the quality, productivity, and life that is thriving in the water of Lake Clark National Park and Preserve.

Follow them on Facebook at: www.facebook.com/AlaskaNPS

Who is SWAN?

- SWAN will also measure and monitor:
  - Wildlife
  - Marine (near shore environments)
  - Weather, Climate and Air Quality
  - Fresh water flow systems

Check them out on YouTube: www.youtube.com/user/swanNPS

Who is SWAN?

- These men and women are using high tech equipment to monitor change as they happens. They travel all over Alaska measuring water quality.
  - They are taken over bodies of water in float planes or by boat
  - They spend all summer living in remote areas studying and gathering data
  - They are hiking mountains and swimming in lakes that are only accessible by air

Check out more about SWAN at
science.nature.nps.gov/IM/units/swan/index.cfm

Just a quick review…

- What is Dissolved Oxygen?
- What is Turbidity?
- What is pH?
- What is productivity?
- Explain Water Quality.
- Who is the SWAN team?
- What can you do to help maintain water quality?

Lake Clark National Park and Preserve

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EXPERIENCE YOUR AMERICA

Thank you to my Sources

- http://water.usgs.gov/edu/turbidity.html
- http://serc.carleton.edu/microbelife/research_methods/environ_sampling/turbidity.html
- http://water.usgs.gov/edu/ph.html
- A Citizen's Guide to Understanding and Monitoring Lakes and Streams
- NPS website www.nps.gov
- http://science.nature.nps.gov/im/units/swan/assets/docs/reports/inventories/BennettL_2005_KEFJ_WQInventory_050420.pdf