***Making Connections with Water Quality***

**Introduction:**

In this unit, students will study the health of a water system by determining the balance between physical, chemical and biological variables. Physical variables include temperature, turbidity, and water movement. Chemical variables include dissolved oxygen and other gases, pH, nitrates, and salinity. The health of water systems is dependent on the balance of its many natural systems. Students will focus on contaminants that harm our water quality and will research means of water filtration.  This unit is designed to encourage students to apply prior knowledge of technology and water to determine if local water is safe for consumption.

Disasters can strike anywhere in the world with little or no warning. These disasters have a great impact on the water supply which can affect every living organism.  The extension will utilize a WebQuest that will have students explore natural disasters such as, tsunamis, hurricanes, floods, volcanoes and earthquakes. It will also explore the major effects of natural disasters on our water supply.  Students will focus on contaminants that harm our water quality and will research means of water remediation.  Students will also work with their families to create a family communications plan utilizing knowledge of emergency preparedness.

**Learning Outcomes:**

* Students will understand that the health of water systems is dependent on the balance of its many natural systems.
* Students will understand that water may contain harmful contaminants and needs to be tested for specific contaminants.
* Students will understand that bio-indicators are studied to indicate environmental quality.
* Students will understand that chemicals, hazardous wastes, oil, and etc. collected from soil can be transferred to ground water supply.
* Students will understand that individual and collective actions are needed to effectively manage water resources.
* Students will understand their role as stewards of our environment.

**Curriculum Alignment: North Carolina Essential Standards**

**8.E.1.3**

* Students will predict the safety and potability of water supplies in North Carolina based on physical and biological factors, including:
	+ Temperature
	+ Dissolved Oxygen
	+ pH
	+ Nitrates and phosphates
	+ Turbidity
	+ Bio-indicators

**8.E.1.4**

* Students will conclude that the good health of humans requires:
	+ Monitoring of the hydrosphere
	+ Water quality standards
	+ Methods of water treatment
	+ Maintaining safe water quality
	+ Stewardship

**Reading Standards for Informational Text**

* Grade 6
	+ Craft and Structure-4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative and technical meanings.
	+ Integration of Knowledge and Ideas-7. Integrate information presented in different media or (e.g. visually, quantitatively), as well as, in words to develop a coherent understanding of a topic or issue.
* Grade 7
	+ Craft and Structure-4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative and technical meanings; analyze the impact of a specific word choice on meaning and tone.
* Grade 8
	+ Craft and Structure-4. Determine the meaning of words and phrases as they are used in a text, including figurative, connotative and technical meanings; analyze the impact of a specific word choice on meaning and tone.

**Language Standards**

* Grade 6,7, & 8
	+ Vocabulary Acquisition and Use-6. Acquire and accurately use grade appropriate general academic and domain specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**Reading Standards for Literacy in Science and Technical Subjects- Grades 6-8**

* Key Ideas and Details-3. Precisely follow a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks.
* Craft and Structure-4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

**NC Essential Standards**

* 6-8 Science- Science as Inquiry:
	+ Traditional laboratory experiences provide opportunities to demonstrate how science is constant, historic, probabilistic, and replicable. Although there are no fixed steps that all scientists follow, scientific investigations usually involve collections of relevant evidence, the use of logical reasoning, the application of imagination to devise hypotheses, and explanations to make sense of collected evidence. Student engagement in scientific investigation provides background for understanding the nature of scientific inquiry. In addition, the science process skills necessary for inquiry are acquired through active experience. The process skills support and are the core of scientific methodologies.
* 6-8 Information and Technology Standards. Apply a research process for collaborative or individual research.
	+ 1.1- Implement a research process collaboratively.

**Critical Vocabulary:**

* Water quality: used to describe the health of a water system
* Temperature: measure of average kinetic energy
* Dissolved Oxygen: measure of water quality indicating free oxygen dissolved in water
* pH: the measure of how acidic or basic a substance the acidity neutrality or basicity of a substance
* Hardness: that quality in water that is imparted by the presence of dissolved salts
* Nitrates: nitrogen compounds used for growth by plants and algae
* Turbidity: measure of the degree to which water loses its transparency due to the presence of suspended particulates.
* Eutrophication: natural process that ultimately turns a lake into dry land over time through an increase in sediment, nutrients and organisms
* Bio-Indicators: macro-invertebrates found living in water that are sensitive to pollution and are used to assess the health of a water system
* Pollutant: any substance or form of energy that can cause harm to the environment and make it unfit for use by organisms
* Point-source pollution: pollution that can be traced to a specific source such as oil that spills from a pipeline
* Nonpoint-source pollution: pollution that comes from many places or sources that is not easily identified
* Macro-organisms: small, spineless creatures that are visible with the unaided eye
* Stewardship: responsibility for conserving and restoring the Earth’s resources for future generations

**Classroom Time required:**

* 5-11 class periods of 45-60 minutes.
	+ Engage (45-60 min)
	+ Explore (45-60 min)
	+ Explore ppt. (45-60)
	+ Explain (45-60 min)
	+ Elaborate( 2 classes of 45-60 min)
	+ Evaluate (30 min)
	+ Extension (1 week computer WebQuest activity)

**Materials Needed:**

* Explore:
	+ Would you use this Water? And “Indicators of Water Quality” PowerPoint
		- Flashlight
		- 3x5 card
		- Thermometer
		- pH test strips
		- several clear container or beakers
		- ammonia, bleach or cleaning solutions to demonstrate bases
		- lemon juice, vinegar or anything to demonstrate acids
		- flour to demonstrate cloudy water
		- dirt to demonstrate very turbid water
		- pond, lake or ocean water (optional)
		- Water quality kits if station rotations are desired for student experimentation.
	+ A Fish Story:
		- Polluted water (created through the story)
		- Small plastic fish
		- Soil
		- Oil
		- Salt
		- Detergent
		- Red food coloring
		- Copy of “A Fish Story”
	+ Indicator of Water Quality PowerPoint
* Explain: WaterFaucetVocab and print for station activity
* Elaborate**:** Using Mrs. Smith Engineering Goodies wiki, download and print copies of the “The Engineering Design Process Worksheet.” <https://mrssmithsengineeringgoodies.wikispaces.com/file/view/06%20Engineering%20Design%20Process%20Worksheet.pdf/408168188/06%20Engineering%20Design%20Process%20Worksheet.pdf>

Filtration materials may also include the following items: 2 liter bottles, charcoal, newspapers, wood chips, rice, paper towels, cotton balls, small gravel, sand, plastic or foam cups, coffee filters, gauze/fabric strips

* Evaluation
* WebQuest: <https://sites.google.com/site/codesandwater/process>

**Technology Resources:**

* Computer
* Overhead/projector
* Internet connection

**Student Pre-activities:**

* Students will need to understand basic knowledge of the hydrosphere.
	+ Freshwater
	+ Surface water
	+ Groundwater
	+ Permeable
	+ Impermeable
	+ Aquifer, watersheds
	+ River basin
	+ Water cycle
	+ Properties of water
* Visit NCDPI website to find lesson plans for the above topics: <http://www.ncpublicschools.org/docs/curriculum/science/middlegrades/8thsciencesupport.pdf>

**Teacher Pre-activities:**

* Teacher should review basic knowledge of the hydrosphere with students.
* Explore-A Fish Story

Note to Teachers: The “polluted water” that is created in this next activity will be used in a later lesson (Elaborate) in which students will develop their own water filtration system. After completing this portion of the lesson, you may wish to introduce the water filtration lesson to let students begin thinking and researching methods that they may want to use for their project.

Prior to the lesson, you will need to create a “Fish Habitat” in a container such as a small aquarium or clear plastic tote. Fill the container with clean water. Place a small plastic fish (or cut one out using construction paper and tape to outside of container) soil, oil, salt, detergent, and red food coloring. You will also need a copy of “A Fish Story” from the following website: <http://www.readwritethink.org/lesson_images/lesson1035/fish-story.pdf>

**Pre and Post-Assessment:**

* Evaluation: Pre/Post Assessment

**Activities**

***Engage***

Must Have or Do Without

* Write the following quotes on the board for students to read:

*“Most human beings have an almost infinite capacity for taking things for granted”.* [*Aldous Huxley*](http://www.brainyquote.com/quotes/authors/a/aldous_huxley.html)

*“It's not a bad idea to occasionally spend a little time thinking about things you take for granted”. Plain everyday things.* [*Evan Davis*](http://www.brainyquote.com/quotes/authors/e/evan_davis.html)

* Ask students to think about the above quotes and then discuss their meaning.
* Discuss how as Americans we take many things for granted.
* Have students write down some things that they take for granted. Ask students to share their list of “taking for granted”, and record them on the board.

Examples: Phones, food, radio, microwaves, clothing, homes, parents, family, friends, health, water, time, cars, school, candy, soda drinks, fast food

* In groups/partners/individuals: Ask students to prioritize the items as “must have”, “do without”, or “hard to live without”.
* Have students share the items they could “do without” and then ask them to share their list of “must haves”.
	+ Eventually they should come to the agreement that the only things they must have are food, shelter and clothing.

Discuss the importance of the “must haves”.

* Will the “must haves” always be readily available?
* Are there any hazards of taking the items for granted?
* Explain to class that they will be learning about the health of water and why it is important to take care of our water and not take it for granted.

To read more quotes, visit the site below. <http://www.brainyquote.com/quotes/quotes/e/evandavis481941.html#4u7O4IuKxTRTrExr.99>

Give Me Five

* On a sheet of paper, have students trace their hand.
* Instruct students to write the following as directed.
	+ Palm = Define Water Quality
	+ Thumb = Biggest Problem with Water Quality
	+ Fingers = Factors Affecting Water Quality or Ways to Determine the Health of a Water System
* Instruct students to share with partner/group their responses. Have students share with whole class.

Research the clean water act/safe water act. Use computer lab for individual/blended classroom or overhead for classroom research.

EPA: United States Environmental Agency: <http://www2.epa.gov/laws-regulations/history-clean-water-act>

Teacher Information: Clean Water Act: The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

The 1972 amendments:

* Established the basic structure for regulating pollutants discharges into the waters of the United States.
* Gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry.
* Maintained existing requirements to set water quality standards for all contaminants in surface waters.
* Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.
* Funded the construction of sewage treatment plants under the construction grants program.
* Recognized the need for planning to address the critical problems posed by nonpoint source pollution.

***Explore***

Would you use this Water?

Show students the containers (beakers) of water. (Keep and use these containers for demonstration to illustrate turbidity, temperature, and pH when presenting Water Quality PPT)

* 1. One container should have clear water with a small amount of ammonia, bleach or cleaning solution mixed in it.
	2. Second container should have water with flour mixed in to make it cloudy.
	3. Third container should have distilled water.
	4. Fourth container should have water with dirt.
	5. You may add other containers of different types of water such as pond, lake or ocean or different pH such as lemon juice, milk, and coffee.
1. Label the containers #1, #2, #3, and #4 and etc.
2. Ask questions as to which container the students would cook, clean, bathe, swim, or clean. Use the discussion questions to focus students’ thinking on drinking water.

A Fish Story

1. Read “A Fish Story” to your students.
2. As you read the story, add materials to the water as indicated in the story.
3. Stop to discuss the questions as you read.
4. Have students record the cause and effect of water pollution due to human activities using the graphic organizer from readwritething.org. <http://www.readwritethink.org/files/resources/lesson_images/lesson1035/cause.pdf>

Good website to illustrate water filtration: <http://www.epa.gov/ogwdw000/kids/flash/flash_filtration.html>

Indicators of Water Quality

Present the “Indicators of Water Quality” PPT.

* Use containers of water from the above activity to use as a demonstration during the power point.
	+ Demonstrate turbidity with container of water and dirt. Using a flashlight, demonstrate how the light does not shine through the water compared to the fresh water container.
	+ Place 3x5 index card, marked with an X, under the container to show comparisons of different containers and the level of turbidity of each.
	+ Demonstrate how heat could get trapped on the top layer of turbid water and discuss the results of heated water while talking about temperature.
	+ Use each container to test pH levels while demonstrating acids and bases.
	+ If you have access to pond water full of algae, demonstrate what nitrates and phosphates will do to the quality of water.
	+ Create station rotations when lesson is completed and have students test for water quality. Water quality kits are available in most science supplies vendors.

***Explain***

Water Faucet Vocabulary

Place an information page and matching question card at a station. Allow students to rotate between the stations and find answers to all the questions. Lead a discussion of the questions once the activity is complete.

***Elaborate***

Create a Water Filter System

Ask students to complete the worksheet using the information below for problem, requirements and constraints. Students will work in groups/partners/individuals to complete the remainder of the assignment.

Step 1 Ask: (Teacher will provide the following underlined information)

* What is the problem?
	+ Must create a ground filtering system that will clean dirty water.
* What are the requirements?
	+ Filter must allow water to flow into a clear container that will capture water and allow for observation of filtered water.
* What are the constraints?
	+ Filter must not allow water to spill onto any objects and should be able to sit on a table.

Step 2 Imagine:

* Brainstorm ideas
* Choose the best one

Step 3 Plan:

* Draw your design
* Gather necessary materials

Step 4 Create:

* Follow your plan
* Test it out (Done in class with prepared dirty water)

Step 5 Improve:

* Does it meet requirements?
* Does it meet constraints?
* Start again to improve your design.

You may use the following rubric for grading this activity--<https://mrssmithsengineeringgoodies.wikispaces.com/file/view/09%20Engineering%20Design%20Process%20Grading%20Rubric.pdf/408188562/09%20Engineering%20Design%20Process%20Grading%20Rubric.pdf>

***Evaluate***

Use the Evaluation document as a post-assessment of the unit.

***Extension***

WebQuest

Divide the class into teams of four. Each team member will have a specific task to complete. Once the team members have gathered their information, the team will use the Big 6 Research Model to research issues concerning water quality after natural disasters. The webquest is available at the following website: <https://sites.google.com/site/codesandwater/home>.

**Community Engagement:**

* Arrange to take students to a local waste water treatment plant.
* Research local manufacturing companies to investigate their methods of water treatment.
* Identify local laws and agencies which monitor water quality.
* Identify environmental groups which monitor water quality.
* Invite local environmental engineers to speak to students and demonstrate methods of collecting water quality data.
* Invite Local Amateur Radio Operators to demonstrate how to make a receiver and transmitter to communication during emergency. HAM Radio does not rely on an infrastructure and is the best means of communications when other means are out of commission.

**Modifications:**

* The teacher can upload the Power Point presentation to their website or local school server and have the students navigate the lesson independently for homework, in order to save class time.
* The teacher should direct students with reading disabilities to the narration in the Power Point if students are working independently.
* If lab equipment and supplies are limited, the teacher may wish to conduct the experiments as a classroom demonstration throughout the Power Point presentation.
* For ESL students, monitor student’s comprehension of language used during instruction and schedule frequent, short conferences to check for comprehension.
* Allow for oral administration of assessment.

**Alternative Assessments:**

* The Fish Kill Mystery: Students read the case study and answer questions at the end of article. <http://sciencecases.lib.buffalo.edu/cs/files/fishkill.pdf>

**Websites and resources:**

* Water’s the Matter: <http://peer.tamu.edu/curriculum_modules/Water_Quality/Module_5/index.htm>
* What’s In Your Water: <http://extension.usu.edu/waterquality/htm/whats-in-your-water>
* How Do We Measure the Quality of the Waters: <http://water.epa.gov/learn/resources/measure.cfm#scientists>
* Aquatic Macro invertebrates: <https://extension.usu.edu/waterquality/htm/whats-in-your-water/aquatic_macroinvertebrates>
* Iowa Public Television: Explore More Water Quality <http://www.iptv.org/exploremore/water/>
* Bio-indicators and Water Quality: <http://www.aims.gov.au/docs/research/water-quality/runoff/bioindicators.html>
* How do we measure the Quality of our Waters? <http://water.epa.gov/learn/resources/measure.cfm>
* Groundwater and Drinking Water: <http://water.epa.gov/drink/>

**Comments:**

Extension: This activity was designed to help students become stewards of their environment. Some highlights of the activity:

* CommScope Engineer brought technology into the classroom to show students the power and efficiency of today’s global communication.
* Local HAM radio operators visited the 8th grade and 6th grade class to create radio transmitters and receivers. Students were able to use Morse code to send messages to each other.
* 8th grade students, after completing their lesson, assisted with the 6th grade students as they created transmitters and receivers.

Collaboration is an important and vital part of creating lessons. A special thanks to the people who were of great support during the process of creating this unit:

* Instructional Technology Coordinator: Kathy Beck
* Media Coordinator: Karen VanVliet, Kim Delforge
* Faculty and Staff at Troutman Middle School
* Kenan Fellows 2013-2014 Cohort
* CommScope Mentor: Doug Blew
* Iredell County Amateur Radio Society (ICARS): Howard Hecht, William (Buzz) Borries, Donald Humphrey

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I am currently in my seventh year of teaching Science at Troutman Middle School for Iredell-Statesville schools. I continue to grow in, and enjoy my profession. My classroom is a blended classroom, implementing traditional methods of teaching as well as integrating technology. I strive to use technology daily and am continuously searching for exemplary lessons, tools and resources that easily enable me to implement new ideas.

Achievements

* Kenan Fellows 2013-2014 Cohort
* Teacher of the Year 2009-2010
* Bright Ideas Writer and Grant Recipient
* Statesville Landmark and Record: Innovative Technology
* ISS Innovative Showcase Breakout Session Presenter 2012 & 2013

Education

* Master’s Degree in Executive Leadership, 2012
* Bachelor’s Degree in Education, 2007
* Associate Degree in Science, 2005
* Diploma in Music/Education, 1981

**Water Faucet** **Vocabulary**

**Turbidity:**

Turbidity is the amount of suspended particles (not necessarily related to water color) that prevent the penetration of light through the water. Turbidity is often caused by phytoplankton (single celled algae) or sediment in the water column. Submerged Aquatic Vegetative (SAV) needs light for photosynthesis, and fish need SAV for food, shelter, and oxygen. If suspended particles “block our” light, then these underwater life forms can’t thrive. Turbidity can prevent fish from finding food and from operating effectively within their environment. It can also clog the gills of fish and shellfish, killing them directly.

The shallowness of sounds and estuaries make them extra vulnerable to turbidity. Natural forces like high winds, hurricanes, and rain storms stir up sediments on the bottom, increasing the cloudiness of the water. Man-made disturbances can include boat propellers, sediment from construction sites too close to the water, and dredging.

For more information on Turbidity: <http://extension.usu.edu/waterquality/htm/whats-in-your-water/turbidity>

**Dissolved Oxygen:**

Dissolved oxygen (DO) is the amount of oxygen dissolved in water, measured in parts per million (ppm) or milligrams per liter (mg/l). DO is a critical factor for most aquatic organisms and is one of the most important indicators of environmental health. When oxygen levels in water fall below 4 ppm, fish and other aquatic organisms become severely stressed; below 2ppm, many can’t survive. Oxygen is added to the water from the air through the churning action of the wind. Underwater plants (SAV) also supply oxygen to the water during photosynthesis. Salinity can also affect DO. As salinity increases, DO potential in the water decreases.

DO levels in an estuary vary seasonally, with the lowest levels usually occurring during the summer months. Cold water can hold more oxygen than warm water, so levels naturally increase during the fall and winter. Bacteria, fungi, and other organisms affect DO levels in an estuary, because they consume oxygen while breaking down organic matter (dead plants and animals).

For more information on Dissolved Oxygen: <http://extension.usu.edu/waterquality/htm/whats-in-your-water/do>

**Temperature:**

Temperature is a critical factor when determining water quality. Many biological, physical, and chemical principles, as well as, feeding and reproduction of aquatic life are temperature dependent. Temperature is defined as the degree of hotness or coldness measured on a definite scale. Some bodies of water have temperatures that remain fairly constant, but that is not the case for rivers, sounds, and estuaries. Because they have a variety of depth and are affected by currents, the temperature varies greatly depending on a number of factors, especially the seasons.

In the spring and summer in NC, the sun warms the surface waters and the deeper waters stay a bit cooler. The surface waters cool down in the fall, becoming more dense than the bottom waters. The density causes surface water to sink to the bottom, pushing the bottom waters closer to the surface. This “turn over” or upwelling is very important to the health of a water system. This process provides a mechanism for the nutrients which have settled to the bottom, to be stirred up and released into higher water levels. These nutrients are essential to the growth of all organisms.

The temperature of the water is also critical in determining where marine organisms live and how well they thrive there.

**pH:**

pH is a measurement of how acidic or basic something is. It is measured on a scale from 0-14. Acidic values are from 0-7, with 0 being the most acidic. Basic numbers are from 7-14. A neutral pH is 7 (an example of this would be distilled water). The pH scale, like the Richter scale, is logarithmic. This means that each unit change (e.g., 5 to 6) is a tenfold change in the pH of the substance. Water with a pH of 5 is 10 times more acidic than water with a pH of 6.

Changes in pH can be caused by humans through emissions from automobiles and coal-fired power plants that contribute to acid rain, or by a natural process due to soils and vegetation. Water with an extremely high or low pH is deadly. Water with relatively low pH (acidic) may reduce the hatching success of fish eggs and irritate fish and aquatic macro-invertebrates (water bugs) gills and damage membranes. Amphibians are particularly vulnerable, probably because their skin is so sensitive to pollutants. Some scientists believe the recent drop in amphibian numbers around the world is due to low pH levels caused by acid rain.

Information on pH gathered from the following website: <http://extension.usu.edu/waterquality/htm/whats-in-your-water/ph>

**Nitrates:**

Nitrate is one form of dissolved nitrogen that occurs naturally in soil and water. It is the primary source of nutrients for plants and may be used as fertilizer. Most natural concentrations are not a health concern to humans, but when excess nitrates get into water this can pose a problem for human health. Some human activities that introduce nitrates into water are fertilizing, runoff from animal feedlots, leaky septic tanks, industrial wastes and wastewater treatment lagoons.

A nitrate level up to 3 parts per million (ppm) is generally considered naturally occurring and safe for drinking. The U.S. Environmental Protection Agency (USEPA) has set the primary drinking water standard for nitrates at 10 ppm. Concentrations that are significantly higher than the standard may be harmful to people and livestock. There is no standard for private well waters, nor is testing required, which means the private well owner is responsible for testing their own water.

Information on nitrates gathered from the following website: <http://extension.usu.edu/waterquality/htm/whats-in-your-water/nitrate>

**Bio-indicators** (aquatic macro-invertebrate):

What is an aquatic macro-invertebrate? Let's break down the term. "Aquatic" means water, "macro" means big (or big enough for us to see without using a microscope) and "invertebrate" means without a backbone. So an aquatic macro-invertebrate is a water bug that we can see with our naked eye. Many of these macro-invertebrates make their homes in rocks, leaves and sediment in stream beds. Some of these insects and non-insects spend their entire lives in water, like scuds, clams, mussels and snails. However, usually just the larva and nymph stages (the immature stages of insects' lives) are spent in water. Then the larva or nymph will spend it's adult life out of the water.

Bio-indicators are indicators of water quality. Different types of macro-invertebrates tolerate different stream conditions and levels of pollution. Depending on the types of macro-invertebrates found in a stream, predictions about water quality can be made. For example, caddis flies, mayflies, and stoneflies cannot live in polluted water. If these bugs are found in a stream, the water quality there is probably good. However, that doesn't mean that if these bugs are not found in a stream the water quality is bad. Other factors like temperature and flow also come into play. These bugs prefer cold rushing water, so a stream that has good water quality, but is a slow-moving stream in a desert may not have these bugs.

Aquatic macro-invertebrates are also an important part of aquatic and terrestrial food chains. They graze on algae and break down leaves and sticks that fall into the water. They are also an important food source for fish.

Information on bio-indicators was gathered from the following website: <http://extension.usu.edu/waterquality/htm/whats-in-your-water/aquatic_macroinvertebrates>



**Turbidity**

* What is turbidity?
* What is considered “ideal” levels of turbidity? What is considered “high” levels of turbidity?
* What are some causes of turbidity?
* What are the results of high turbidity?
* What is the relationship between turbidity and water quality?



* What is Dissolved Oxygen (DO)?
* What is the average level of DO?
* What level is needed to support diverse populations of fish?
* What causes a change in DO levels?
* What are the results of changes in DO levels?
* What is the relationship between Dissolved Oxygen and water quality?

**Dissovled Oxygen**



* What is temperature?
* What are ideal levels of temperature?
* What are some factors that can cause changes in temperature?
* What are the results from changes in temperature?
* What is the relationship between temperature and water quality?

**Temperature**

* What is the definition of pH?
* On the pH scale, what is considered an acid?
* On the pH scale, what is considered a base?
* What are the ideal levels of pH in fresh water, swamps and salt water?
* What causes a change in pH?
* What are the results of a change in pH?
* What is the relationship between pH and water quality?

**pH**

 

**Nitrates**

* What are nitrates?
* What is a safe level of nitrates in drinking water?
* What are some of the causes of high levels of nitrates?
* What are the results of an excess of nitrates in water?



**Bio-Indicators**

* What are bio-indicators?
* What does a high level of variety of bio-indicators indicate?
* What does a low level of variety of bio-indicators indicate?
* What causes changes in bio-indicators?
* What are the results of low levels of bio-indicators?

**Making Connections with Water Quality: Unit Test** Name: \_\_\_\_Teacher Copy\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| water  | physical variables | chemical variables |
| temperature | turbidity | dissolved oxygen |
| point source pollution | oxygen | macro invertebrates |
| bio-indicators | pH | non-point source pollution |

Use the words in the above table to fill in the blank spaces below. \*Words may be used more than once.

1. The health of a water system is determined by the balance between physical, chemical and biological variables.
2. Chemical variables include dissolved oxygen and other gases, pH, nitrates, and salinity.
3. The health of water systems is dependent on the balance of its many natural systems.
4. Water may contain colorless, odorless, and tasteless contaminants.
5. Temperature is defined as the degree of hotness or coldness measured on a definite scale.
6. Physical variables include temperature, turbidity, and water movement.
7. Oxygen is added to the water from the air through the churning action of the wind.
8. Temperature of the water is critical in determining where marine organisms live and how well they thrive there.
9. Turbidity is the amount of suspended particles that prevent the penetration of light through the water.
10. Dissolved oxygen is the amount of oxygen in water.
11. Macro-invertebrates common in the fresh water of North Carolina include: mayflies, dragonflies, stoneflies, rat-tail maggots.
12. Underwater plants supply oxygen to the water during photosynthesis.
13. Salinity can affect Dissolved Oxygen; as it increases, potential DO in the water decreases.
14. Bacteria, fungi and other organisms affect dissolved oxygen levels in an estuary because they consume oxygen while breaking down organic matter.
15. Macro-invertebrates are organisms that lack an internal skeleton and are large enough to see with the naked eye.
16. Bio-indicators can be classified into three categories: pollutant intolerant, facultative organisms, and tolerant organisms.
17. pH measures the acid/base of water.
18. Bio-indicators are studied to indicate environmental quality such as water flow, pollution and vegetation.
19. Point source and non-point source environmental stressors such as urban and agricultural runoff can impact all aquatic populations.
20. Macro-invertebrates spend most or part of their life cycle in the water, usually the immature phases.

Making Connections with Water Quality: Unit Test Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| water  | physical variables | chemical variables |
| temperature | turbidity | dissolved oxygen |
| point source pollution | salinity | macro-invertebrates |
| bio-indicators | pH | non-point source pollution |

Use the words in the above table to fill in the blank spaces below. \*Words may be used more than once.

1. The health of a \_\_\_\_\_\_\_ system is determined by the balance between physical, chemical and biological variables.
2. \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ include dissolved oxygen and other gases, pH, nitrates, and salinity.
3. The health of \_\_\_\_\_\_\_ systems is dependent on the balance of its many natural systems.
4. \_\_\_\_\_\_\_ may contain colorless, odorless, and tasteless contaminants.
5. \_\_\_\_\_\_\_ is defined as the degree of hotness or coldness measured on a definite scale.
6. \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ include temperature, turbidity, and water movement.
7. \_\_\_\_\_\_\_ is added to the water from the air through the churning action of the wind.
8. \_\_\_\_\_\_\_ of the water is critical in determining where marine organisms live and how well they thrive there.
9. \_\_\_\_\_\_\_ is the amount of suspended particles that prevent the penetration of light through the water.
10. \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ is the amount of oxygen in water.
11. \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ common in the fresh water of North Carolina include: mayflies, dragonflies, stoneflies, rat-tail maggots.
12. Underwater plants supply \_\_\_\_\_\_\_ to the water during photosynthesis.
13. Salinity can affect Dissolved Oxygen; as it increases, potential DO in the \_\_\_\_\_\_\_ decreases.
14. Bacteria, fungi and other organisms affect\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ levels in an estuary because they consume oxygen while breaking down organic matter.
15. \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ are organisms that lack an internal skeleton and are large enough to see with the naked eye.
16. \_\_\_\_\_\_\_\_\_\_\_ can be classified into three categories: pollutant intolerant, facultative organisms, and tolerant organisms.
17. \_\_\_\_\_\_\_measures the acid/base of water.
18. \_\_\_\_\_\_\_\_\_\_\_ are studied to indicate environmental quality such as water flow, pollution and vegetation.
19. \_\_\_\_\_\_ \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ environmental stressors such as urban and agricultural runoff can impact all aquatic populations.
20. \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ spend most or part of their life cycle in the water, usually the immature phases.