

Germ Busters



project WET
WATER EDUCATION TODAY

Topic : How and When to Wash Your Hands

Grade Level : Elementary

Learning Objectives: Students will learn when to wash their hands, how long to wash them, and identify what substances to use to get a thorough clean. They will also learn the importance of using clean water to wash their hands.

Materials Needed:

- Glitter
- Cooking oil
- Two wash basins
- Dirty water
- Clean water
- Sink for kids

Background: Washing your hands is the most effective way to prevent the spread of germs and disease. It is only most effective when done with clean water, soap, and scrubbing for at least 20 seconds. Soap has molecules that function to remove oil, dirt, germs, and other things that cling to our hands. When applied to your hands and rubbed all over, the resulting friction pulls the germs and dirt from your hands and the water cleans them off.

Introduction: Engage the students by asking them how important hand washing is. Ask them to describe the best way to wash their hands. Give them 3 options: only water, random water, soap, and scrubbing, and finally clean water, soap, and scrubbing. The best option being clean water, soap and scrubbing. Ask the students how often they wash their hands and what type of water they use when they wash their hands. Explain to the students that they should be washing their hands after every trip to the bathroom, taking care of pets, before and after eating, and after meeting with someone who is sick.

Demonstration: Cover your hands in a healthy dose of cooking oil and apply glitter. In front of the class demonstrate how dirty water is not as effective when washing your hands, because it will leave dirt on them. Cover your hands in oil and glitter again and then properly wash them in the clean water. Demonstrating that clean water is necessary to properly clean your hands.

Activity: To give hands on understanding to the students, this activity will demonstrate how easily germs can be spread. Choose 3-5 students to be the "infected" have them come up and coat their hands in oil and glitter. One by one, they will shake everyone's hands spreading the "germs". Explain how easily the germs could make them sick if they were to touch their face, eyes, and nose. Once everyone has made contact with the germs. Have them properly demonstrate the hand washing techniques they just learned.

Closing: Remind the students of the importance of clean water and how we can help keep water clean through proper recycling, trash disposal, and more. Repeat the proper steps of good hand washing, and how often to do it.

Aqua Bodies



project WET
WATER EDUCATION TODAY

Topic: Water Composition and Necessity

Grade Level : Elementary

Learning Objectives: Students will be able to identify the percentage of water in the human body, the locations of water in the human body, and the roles that water plays in the human body.

Materials Needed:

- Copies of human outline (1 for each student)
- Coloring utensils
- Laminated Flashcards with Organs

Background: Around 60% of the adult human body is composed of water, therefore it is essential to keep up the supply. Depending on the location in our body, there is often more water in some places than others. Certain organs require more water than others, such as our skin and our lungs. Water is essential to the building blocks of our bodies: cells. It helps regulate our body temperature, flushing waste, and transport nutrients, and much more.

Introduction: To help the students first grasp the necessity of water intake, divide them into groups of 3-5. Tell them to come up with a list of 5 foods/drinks that they could survive on for one month. (If class is younger elementary, instead of groups, have each student give one answer and list them on the board.) Ask each group why they chose their answer(s). After all of the suggestions have been explained, tell them that the most important resource is water. Explain that the human body is mostly composed of water, 60%, and that we will do an activity to represent just how much that actually is.

Activity: Pass out the copies of the human body and explain that there are 10 blank spaces. Each space is one tenth or 10%. When you add them all up it equals 1 or 100%. Use the laminated copy as an example. Explain that 60% means 6 spaces. Have the students color in 6 of the ten spaces, demonstrating the 60% water composition. While they are coloring, explain 4 main reasons that our bodies need water: 1. It helps cool down our bodies. 2. It helps break down food so our bodies can use it for energy. 3. It helps remove waste from our bodies. 4. It helps keep our organs healthy and functioning.

Demonstration: Explain to the students that water is actually found in different amounts all around the body, that some places have more water than others. Ask the students if they know what organs are. Explain that organs are parts of our bodies that perform certain functions to keep us alive. Using the Organ Water Composition Flashcards show the students some different organs in a random order. Have them guess which organs have the most water and put them in order least to greatest. The percent composition is listed on the back. Once they have made their final decision, flip them over and put them into the correct order. For an older class you can have them sketch the organs onto their aqua bodies.

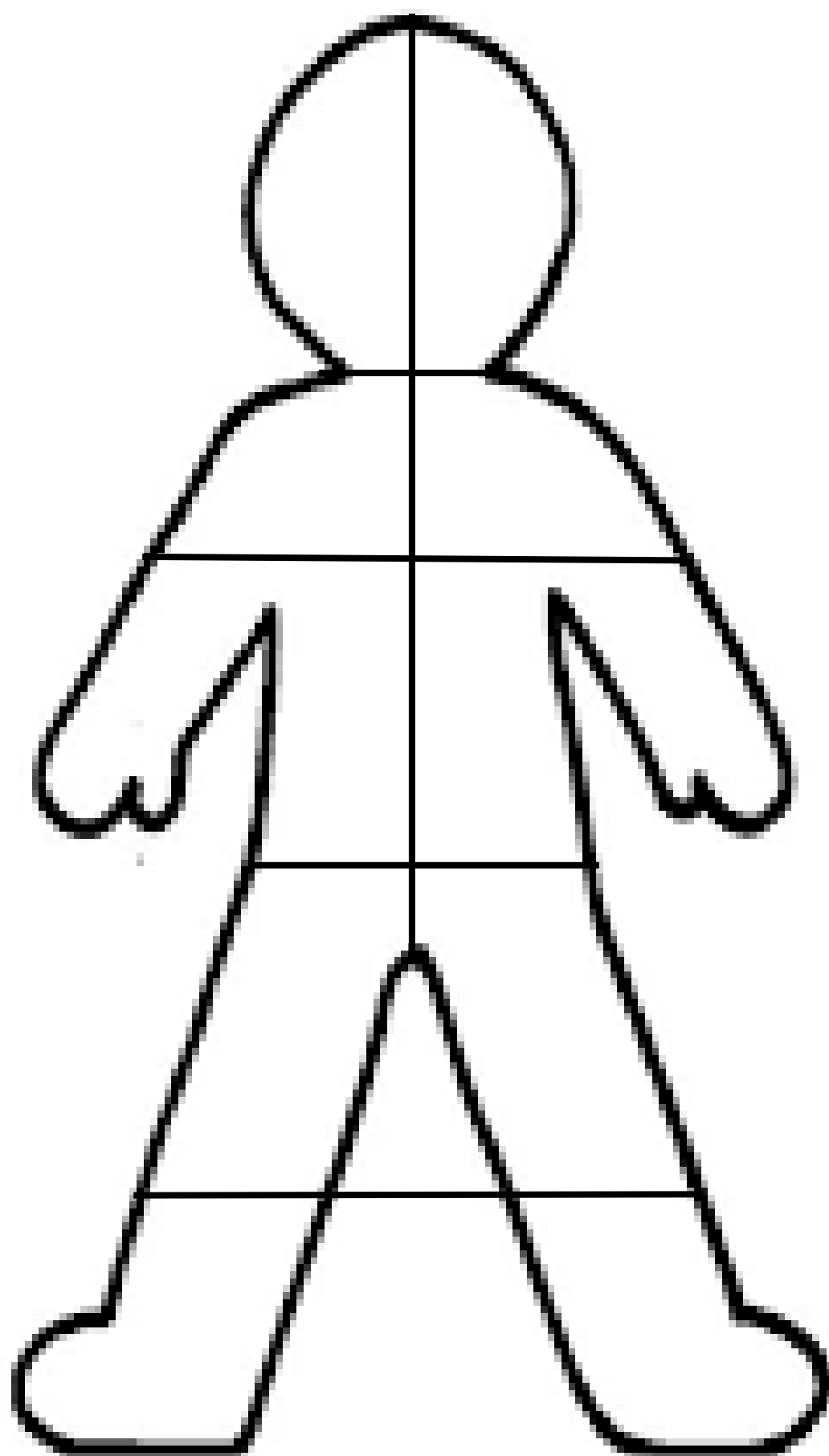
Aqua Bodies



project **WET**
WATER EDUCATION TODAY

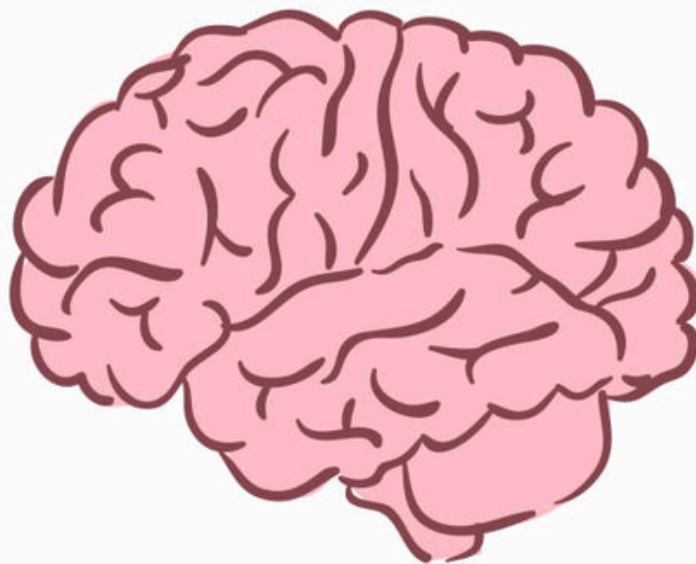
Closing: Remind the students of the importance of drinking water. Have them recite the following:

- "Water is important in my body because it helps cool down when I'm hot."
- "Water is important in my body because it helps break down my food so my body can use it for energy."
- "Water is important in my body because it keeps my organs healthy."
- Water is important because it helps remove waste from my body."

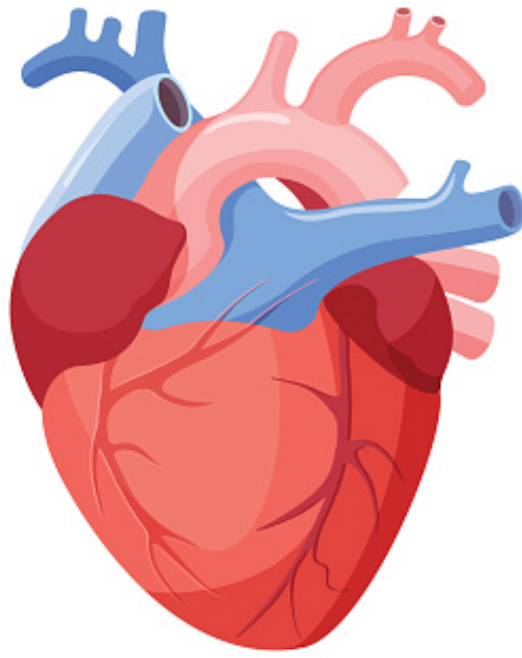




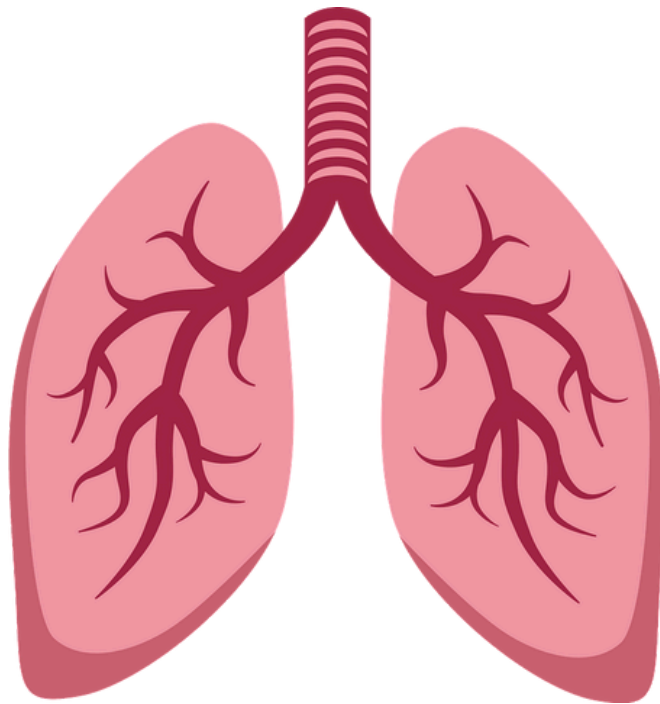
Muscle



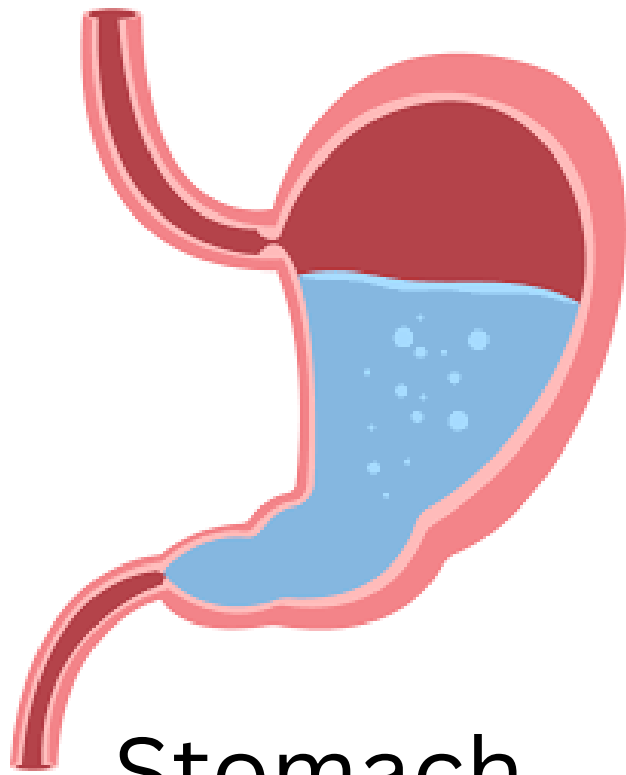
Brain



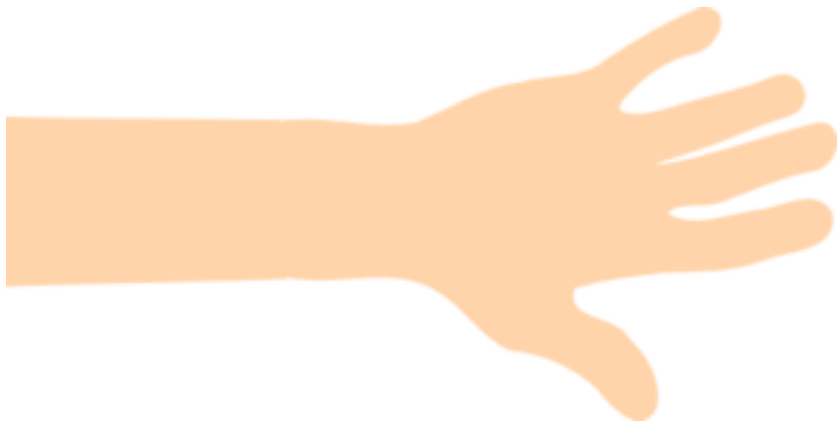
Heart



Lungs



Stomach



Skin

Ask The Bugs



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Topic: Macroinvertebrates: monitoring and habitats

Grade Level : Middle School

Learning Objectives: Students will be able to define a macroinvertebrate and describe their characteristics. They will learn how to analyze the relationship between aquatic macroinvertebrate populations and water quality. By the end, students should have a good understanding of how to evaluate a stream using the water quality index.

Materials Needed:

- Aquatic insect identification (in trunk)
- Aquatic Macro-Invertebrates Insect Identification cards (in trunk)
- Aquatic Bug Kit (in trunk)
 - more materials listed in kit

Background: Before bodies of water can be used for activities such as boating or swimming, they must meet certain standards for the health of those desiring to use them. One of the best ways to determine the health of a water body is by observing the status of its living organisms. This is known as Bioassessment, and it involves the use of biological surveys and other various direct measurements of the specific body of water that is being studied and the examination of the surrounding water shed. They can also be used to provide benchmarks for other bodies of water to be compared to and also to define rehabilitation goals.

Introduction: Ask the students if they can define what an aquatic macroinvertebrate is. After receiving differing answers, clarify that an aquatic macroinvertebrate is an animal without a backbone that lives in an aquatic environment and is large enough to see without a microscope. As the students is they know what the term benthic means. After receiving various answers, clarify that the term is describing an organism that is typically found on the bottom of a body or water, moving or stagnate, that is unable to move extended distances. Therefore, the reason that they are such valuable tools for pollution detection is because they cannot migrate away from the harmful substances or environmental stressors. Being able to identify the different types of macroinvertebrates and their niche's (specialized habitats and conditions that an organism prefers and survives in) can tell a scientist what is going on in the environment. A healthy, unimpacted body of water is often a home to some of the following macroinvertebrates: mayflies, stoneflies, and caddisflies. A body of water that has been impacted and undergone an environmental stressor will usually have organisms similar to the following: leeches, tubiflex worms, and pouch snails. *Both types of organisms can be found in the same habitat, however, only the intolerant species will be found in an impacted area. The most important step in a bioassessment is the proper identification and counting of aquatic insects. The following steps include calculating the relative water quality based on diversity and quantity of the sampled organisms. The most common metrics for calculating are the EPT/Midge Ratio and the Pollution Tolerance Index. We will further discuss these in the activity.

Ask The Bugs



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Activity: *Acquire the aquatic bug kit and look over the instructions prior to use* This activity could take a 2-3 weeks. The instructions within the kit will give a step by step process on what to do and how to handle the macroinvertebrates. The leaf pack can be made by the teacher and then brought in to the class for the lesson.

Demonstration: Assign each student a macroinvertebrate, then conducted a show and tell. Have each student bring in/show an item or image, and explain how it relates to their macroinvertebrate. If students have the same macroinvertebrate, have them explain how their items/images could work together, if possible, for their macroinvertebrate. Once all students have presented, designate two desk. Desk one being a body of water that has been impacted and undergone stresses. Desk two being a unimpacted body of water. Have each of the students place their item/image on the desk that corresponds with their macroinvertebrate (Mayfly on unimpacted).

Closing: Open a discussion with the students. Ask them what macroinvertebrates are, how they can help in determining stream quality, and how to handle macroinvertebrates. Allow the students to keep a conversation open about macroinvertebrates amongst themselves for a few, as this will allow them to demonstrate what they learned.

Oh Frog



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Topic: Eutrophication effect on aquatic habitat requirements

Grade Level : High School

Learning Objectives: Students will demonstrate the effects eutrophication has on aquatic habitats and define what aquatic habitat requirements there are.

Materials Needed:

- Screen (to play video)
- Room to move
- Tape

Background: The basic terrestrial habitat requirements are food, water, and shelter. Aquatic habitats, however, require oxygen in place of the water. Eutrophication is caused when excessive nutrients (such as Nitrogen and Phosphate) get into water systems and cause algal blooms. An algal bloom is the rapid growth of microscopic algae in water, often resulting in a colored scum on the surface. This scum blocks light from entering the water, thus killing aquatic plants. Eventually, the algae will die and bacteria will break down the decomposing plants. This bacteria uses up the dissolved oxygen in the water, which kills aquatic animals that did not swim away in time. Dissolved oxygen is a measure of how much oxygen is dissolved in the water, AKA, the amount of oxygen available to living aquatic organisms. Eutrophication most commonly occurs due to human activities, such as runoff into the water system. This means that the nutrients from fertilizers used on farms, golf courses, and lawns can be washed by rain into water systems.

Introduction: Ask the questions stated below, and have the students move to a designated side of the room to answer. For explain, "If you have been swimming before, move to this side of the room (point to the right) if you have not been swimming before, move to this side of the room (point to the left)." The questions are the following:

1. Have you been swimming before?
2. Do you prefer to swim in the pool or the lake?
3. Do you like fishing?
4. Have you ever seen algae?

After, have the students will find their seats and a provide some background on aquatic habitats. Tell your students that there are three basic requirements for aquatic organisms to live: food, shelter, and oxygen. Ask your students what they believe would happen if just **one** of these requirements was unavailable within the habitat.

Oh Frog



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Activity: Create two parallel lines (with tape) 10-20 yards apart on the ground. Then have your students count themselves off, 1-4. The students who were 1's are the frogs, and then need to be on one of the two lines. Students who were 2-4 are habitat requirements and must be on the other line. The students who are habitat requirements may pick what requirement they would like to be at the beginning of each round. If the student chooses to be food, they need to hold their hands out in front of them (like they are offering a gift). If the student chooses to be shelter, they need to have both hands on top of their head. And if the student chooses to be oxygen, they need to plug/pinch their noses. After you have explained the previous information, have all the students close their eyes, and the students who are habitat requirements pick what requirement they would like to be by doing the hand motion (you do not need an even number of each requirement). After students have picked their habitat requirement, have them open their eyes. Explain to your students that the frogs are going to go to the habitat requirements and take back 1 individual for every requirement. That means that whoever is playing the frog has to walk to the individuals playing as habitat requirements and bring back an oxygen, food, and shelter to their line. If the individual playing the frog can not get all three of their requirements, they "die" and become a habitat requirement. This means they move from the first line (Frogs) to the second line (habitat requirements). If a frog finds all three requirements and brings them back to their line (line 1) those requirements become frogs. This means they move from the second line (habitat requirements) to the first line (frogs). Play 2-3 rounds to ensure your students understand the basics. After 2-3 rounds, pick 1-2 students from the habitat requirement line. The students you picked are now excessive nutrients, and they are going to cause eutrophication. The students who are excessive nutrients will move off to the corner of the room, not on one of the lines. At the beginning of the next round, the students who are excessive nutrients will attempt to get to the oxygen before the frogs. If the student who is excessive nutrients successfully takes an oxygen back to their corner, the student that was an oxygen becomes excessive nutrients. Continue playing until there is no oxygen/frogs left.

Demonstration: Ask the students what happens when excessive nutrients was introduced in the game. How did it affect the ecosystem? Guide the students by asking questions that will push them to the correct answer. Once the students conclude the excessive nutrients took away the oxygen and killed the frogs, play this one-minute video by the national ocean service (<https://oceanservice.noaa.gov/facts/eutrophication.html>). After showing the students the video, have them identify (from the following images) what is an algae bloom. Explain to the students how we can help prevent algae blooms.

1. Use soaps and detergents with less phosphate
2. Use only the recommended amount of fertilizer, when necessary
3. Reduce runoff (redirect down spouts so they do not lead to a water source, plant trees, plant a rain garden, use a rain barrel to collect rainwater)

Closing: Ask the students what causes an algae bloom. Once they completely understand algae blooms, ask them what they can do to help prevent them.



The example of a water system with an algae bloom is above.

The example of a water system without an algae bloom is below. (This water system is full of sediment, which is why it is this color)



Rainfall



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Topic: Understand a rain gauge, and how to measure rainfall

Grade Level : Middle School

Learning Objectives: Students will be able to read the CoCoRaHS rain gauge and use it to measure rainfall for two weeks.

Materials Needed:

- CoCoRaHS Rain Gauge (in trunk)
- 100 Pennies and a dollar bill
- Somewhere to hang the Rain Gauge

Background: The CoCoRaHS (standard 4 inch plastic) rain gauge is designed to hold a total of 11 inches. That is A LOT of rain! (One inch in the inner tube, and 10 additional inches of 'overflow' can be collected in the outer tube.) Rain gauges are usually designed with the collecting part at the top, funneling down to an inner tube inside the gauge. This way, we can easily record measurements in 1/100 inch increments.

Introduction: Examine the rain gauge as a group and discuss the measurements:

1. What kind of measurement is this?
2. Why does the rain gauge show such a tall inch?
3. Explain hundredths by using the dollar bill and the 100 pennies

Explain: An inch of rain is just what it sounds like – one inch of water. It is one inch long, one inch wide and one inch tall. After, ask your students "how much rain would you have if you have one inch of rain (depth) over an area of 12 inches long by 12 inches wide? ($12 \times 12 \times 1 = 144$)

Activity: Show the rain gauge and explain that rain gauges are usually designed with the collecting part at the top, funneling down to an inner tube inside the gauge. This way, we can easily record measurements in 1/100 inch increments. To show this, take the funnel and inner tube out of the gauge. Next, fill the OUTER tube with water up to approximately 1 inch (hold a ruler next to the gauge to determine 1 inch, or estimate...). Explain to the students that it just rained...about an inch. Ask the students if this is exactly one inch? How do they know? The increments are so small, it could be more, it could be less...Next, pour this water directly into the INNER tube, filling it to the top. Notice the increments on the inner tube. One inch is labeled at the top, with 1/100th markings up the side. Was it exactly 1 inch? You may find out that is .98 or it may have passed the 1 inch line. This is why the inner tube is used... This allows us to accurately measure smaller, more common amounts of rain. If we had to measure directly, we could never measure rainfalls like 0.05 inches. To show this, take .05 from the INNER tube and pour it back into the OUTER tube. Can you accurately measure .05 this way? Now try different amounts in the INNER tube and practice reading the measurements (from the bottom of the meniscus). How would you measure a rain event over one inch? After recording the first inch from the inner tube, pour it out. Next, pour the remaining rain from the OUTER tube into the INNER tube and add it to your previous amount that was just recorded.

Rainfall



project **WET**
WATER EDUCATION TODAY

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Demonstration: Set the rain gauge up outside by attaching it to a post/side of building. Over the next two weeks, have the students measure the rainfall using the rain gauge. Ask them to determine how much rain would have fallen per one square foot based on their measurement (12x12xTHEIR MEASUREMENT). Keep the records in your classroom where the students can view them easily. At the end of the two weeks, ask the students what they noticed? Are there any trends in their rainfall data?

Closing: Provide each student a piece of paper and a pencil, tell them to draw the lines in an inch on the paper using the whole paper (The left side of the paper is 0 inches, the right side of the paper is 1 inch). After, ask the students to explain how much rain an inch of rain was. How does the inner tube help to determine the measure of rain? How much rain can the CoCoRaHS Rain Gauge hold?



Anderson County
SOIL & WATER
CONSERVATION DISTRICT



COLORADO STATE UNIVERSITY
EXTENSION

Part of this lesson comes
from Colorado State 4-H

Is it Safe?



project WET
WATER EDUCATION TODAY

Topic: Testing nitrate and nitrogen within water systems and determining effects

Grade Level : High School

Learning Objectives: Students will be able to properly test water using the Lamonte Nitrate-Nitrogen Testing Kit and determine the waters health.

Materials Needed:

- LaMonte Nitrate-Nitrogen Testing Kit (In Trunk)
- Water Samples
- Protective gear (Goggles, gloves)

Background: Nitrate is an inorganic compound that doesn't occur naturally in groundwater. Levels of 2 parts per million and less are commonly found in groundwater supplies due to human activities on the land surface. Nitrate is a common non-point source contaminant (non-point source means that there isn't one direct source of the contaminant that can be identified as the cause of the contamination, but instead many smaller contributors that lead to the problem). What is the difference between nitrate and nitrite? Nitrogen is present in many forms in our environment. Nitrogen undergoes a variety of chemical reactions and changes that result in the production of nitrogenous compounds, two of which are nitrate and nitrite. Nitrate (NO_3^-) is the form that is most commonly found and measured in soil and water. Nitrite (NO_2) is also part of the nitrogen cycle and is the ion that gets converted into nitrate. This is the Nitrogen cycle between the soil and atmosphere. Nitrate goes through a different chemical pathway in the human body. The most common sources of nitrate in our local area that may cause water quality problems are plant fertilizers, excess animal and wildlife manure, and malfunctioning septic systems. Nitrate moves easily with water because of its negative charge, NO_3^- . Therefore, nitrate is not adsorbed by the negatively charged soil particles. Without this attraction, nitrate does not bind to the soil and is leached through the soil with water. Scientific studies have found nitrate to be associated with methemoglobinemia and potentially diabetes, human reproductive issues, and various forms of cancer. Research findings have been mixed and evidence is not conclusive. A limited number of studies have also found links to thyroid dysfunction, impaired immune response, decreased liver function, and respiratory infection and again, results have not been well confirmed. Currently the only confirmed risk is methemoglobinemia or blue baby syndrome. When nitrate is consumed it is converted by bacteria in the body to another chemical form, nitrite. This nitrite conversion is a different chemical pathway then in the nitrogen cycle - other ions in the human body help drive this conversion. Nitrite then interacts with the hemoglobin in red blood cells and reduces their ability to carry oxygen. If the blood cannot deliver enough oxygen to the body's tissues, cells begin to die and the skin takes on a blue tinge. The majority of cases do not result in death and are resolved when the source of nitrate is removed, however this can be pretty scary and if left untreated oxygen deprivation of the body can result in other serious consequences. Treatment for drinking water is limited to reverse osmosis, which is a water treatment process that removes contaminants from water by using pressure to force water molecules through a semipermeable membrane. During this process, the contaminants are filtered out and flushed away, leaving clean, delicious drinking water.

Is it Safe?



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Introduction: Hold up a Water Sample B (ensure before class that this sample is over 10 ppm), and ask students "Who would drink this water?" "Does it look/smell safe?" Pass the sample around while shaking a test tube of Sample B with the N2 tablet added. The sample in the tube should start turning to a bright red. Hide the tube so students can't see the result. Record results of the previous two questions, then bring out the positive sample - have a student read level of nitrate which ideally is over well over 10ppm. Water measuring at or below 10ppm is considered safe to drink. Let's figure out together if this water is safe to drink.

Activity: Review testing instructions page and demonstrate how to do one screening. This is the time to talk about respecting individual's privacy if there are positive tests for nitrate. Each group should have several personal samples, and two control samples. Sample A (0 ppm) and Sample B (over 7 ppm). As the tests are completed have students record the results on postcards/results sheets. Assignment: As the tests results are being waited for, students can roughly sketch a diagram of their household, yard, land around them. As they are drawing they should be identifying potential nitrate sources and what steps can be taken to protect the groundwater from those sources.

Conclusion: After all the test are completed, reveal the control samples (sample A which, ideally, is 0ppm and sample B which, ideally, is 10ppm+). After the screenings are done, ask who was surprised by the results?



Anderson County
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CONSERVATION DISTRICT



Oregon State
University

This lesson comes from
Oregon State University

Rain's Story



project WET
WATER EDUCATION TODAY

Topic: Explore rainfall data and learn how to measure precipitation

Grade Level: Elementary School

Learning Objectives: Students can measure rainfall using a rain gauge and explain the unusual rainfall data from Boulder, Colorado.

Materials Needed:

- CoCoRaHS Rain Gauge (in-trunk)
- Ruler
- Water
- Tarp (if indoors)
- Pencil/Paper
- Screen

Background: Preview this video (<https://www.youtube.com/watch?v=GgLatKFXyXQ>) from minute 1:03-1:37 to get an overview of how to measure the amount of rainfall using a rain gauge. Rain is often measured once in each 24-hour period using a rain gauge that has two cylinders - a narrower one inside a wider one. A funnel collects the rain into the narrower cylinder, which "magnifies" it, allowing one to read rainfall amounts as small as one-one-hundredth of an inch. An unusually wet rainstorm stalled over north-central Colorado from September 9-16, 2013. Rain flooded numerous narrow valleys in the Colorado Front Range, flooding waterways to the east of the Rocky Mountains and causing significant damage. The National Weather Service has calculated that the probability of a rainfall event so large was one in 1000 in this region. Volunteers with CoCoRaHS, including science teacher Bill Schmoker at Centennial Middle School in Boulder, Colorado, measured storm rainfall totals of 15 to 20 inches.

Introduction: Ask students to imagine what it would look like if all the water that fell during a rainstorm stayed where it fell and did not soak into the ground or flow into a river. What depth of water would cover the ground? Would it cover your shoes? Explain that the rain gauge measures the amount of water that falls during a rainstorm in inches so that we know how much water fell to the ground. Explain that water is funneled from a wider area into a narrower area in the gauge, so the measurement scale on the inner tube is enlarged and an inch of rainfall looks much larger. You can demonstrate this by pouring less than one inch of water into the outer cylinder, measuring the depth with a ruler, and then pouring the water into the inner cylinder, which should measure the same amount even though it will appear much deeper. Play this video (<https://www.youtube.com/watch?v=j3UZgy5R5jY>) from the beginning to 1:45 so students see a visual of how to measure rain.

The Rain Gauge Story can be found at the following link if you would like it electronically:
<https://scied.ucar.edu/sites/default/files/documents/Rain%20Story%20UCAR.pdf>

Rain's Story



project WET
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Activity: Select eight students to each read one chapter of the story to the class. (With younger students, plan to read the story to students.) After each student reads a chapter, fill the rain gauge with the water you pre-measured for that day of the story and have one or two students read the gauge. After the students have measured the water for that day, empty the rain gauge and then read the next chapter.

For days during the story when there was more than an inch of rainfall, students will need to follow these steps:

- Measure the amount of water that is in the inner tube and record the number.
- Remove and empty the inner tube.
- Place the funnel on the top of the inner tube and pour the water from the outer tube into the inner tube.
- Measure the remaining water in the inner tube and record the number.
- If there is still more water in the outer tube, repeat steps 2-4 until there is no more water to measure.
- Add all the numbers together to get the rainfall total for that day.

Conclusion: After all the measurements have been collected, ensure the students can see a chart with the data (this can be a graph they make or on the board). Ask the following questions:

- What day experienced the most rainfall?
- What days experienced more than an inch of rainfall?
- On the days that experienced more than an inch of rainfall, how did we accurately measure the rainfall?

Day	Date	Measurement	Rounded to the nearest half inch
Tuesday	9/10/2013	0.94"	1 inch
Wednesday	9/11/2013	1.38"	1 and a ½ inches
Thursday	9/12/2013	8.43"	8 and a ½ inches
Friday	9/13/2013	3.31"	3 and a ½ inches
Saturday	9/14/2013	0.03"	0 inches
Sunday	9/15/2013	0.19"	0 inches
Monday	9/16/2013	1.45"	1 and a ½ inches

This lesson comes from UCAR
Center for Science Education

