Clear, Clean Water – Or is It?

Dear Presenter,

This activity is 30 minute presentation and HANDS-ON lab activity with approximately 25 ten year olds. Please read through the instructions and perform the activity on your own BEFORE you attempt to lead the activity during the water festival.

As each new group of students arrive, introduce yourself, and let the teacher know this is a hands-on lab activity and you will need assistance from him/her. If you do not ask for assistance, the teacher will assume that YOU are the expert and they are the observer. Plan when you will ask the teacher for assistance. Do not hesitate to call the teacher by name and get him/her involved.

As each session begins, introduce yourself to the students. "Good morning, my name is.....and I work for.., I am a ....., or simply I am happy to be here today." Then introduce the topic of the presentation. Each step of this presentation is explained in this packet. These are recommended guidelines and do not have to be followed exactly word for word. Feel free to personalize the presentation to suit you.

Thank you for volunteering to present "Clear, Clean Water – Or is It?." Have fun, enjoy yourself and we hope you will consider volunteering again next year.

Big Sioux Water Festival

MATERIALS LIST

(FOR 6 SESSIONs WITH 25 STUDENTS PER SESSION)

CONSUMABLES

- pH Test strip packet (one per station)
- Chlor-FLOC powder
- Vinegar
- Diet 7-Up
- Baking Soda
- Distilled water
- Cinnamon
- Mint leaves
- 180 student lab sheets – "Water Quality Testing Data Collection Sheet"
- 180 student handouts – "pH scale"
- Poster tac or masking tape to hang pH and Acid Rain posters

NON-CONSUMABLES

- 30 sample jars with lids (5 for each station and a demo set)
- 2 larger jars with lids (for Chlor-Floc demo)
- Pencils (one for each station)
- 6 clipboards (one for each station and one for demo)
- pH poster
- Acid Rain Poster
- Thermometer
- Secchi Disk demo

AREA REQUIREMENTS

- 5 stations
- One table in front of room
- Close to a water source

PRE-PREPARATION

Pre-preparation can include any or all of the following

- Check supplies against supply list
- Review background material from presenter packet
- Make 180 copies of Lab Sheet and pH Value Chart

PREPARATION - Approximately 1 hour to set up

This activity is a hands-on activity. To best explain and supervise this activity you must go through the directions on your own BEFORE the actual presentation

Before you begin: Don't be afraid to ask the teacher and chaperones to supervise at each station.

Background Information

(Background information is provided as a basic overview with both general and specific information. Please share this information with the students.)

Water is one of our most important resources. All living things depend on it for survival and we can see water most everywhere we look. But how do we know that the water we see is clean or healthy enough for us or other animals and plants to use? Sometimes we may see things in water, or maybe the water does not look very clear and we assume it is "dirty" or unsafe, when in fact it could be perfectly safe. On the other hand, and much more importantly, we may take a look at a stream or a lake and not see anything in it or smell anything from it and think that it is "clean" and safe to drink, swim in, or safe for aquatic life (fish, insects, plants) to live in – and it may not be.

Streams move across the land and eventually empty into a lake or the ocean. When it rains other substances wash into our lakes and streams. Like car oil from streets, animal manure from farms, and fertilizers from lawns.

These substances are pollutants that affect the quality of the water. (May need to define a pollutant?). Sometimes that means humans and animals will not be able to use the water.

Water is known as the "Universal Solvent". Has anyone heard of this? Can you tell me why it is called this? Water can dissolve more things than any other substance on earth! Can you give me an example of things that dissolve in water in such a way that you cannot see them? Or smell them? (salt in water, sugar in water).

Just like this water (point to the 5 jars), it may look clear, but you have no idea if there are any other substances in it, unless you test it.

Procedure:

Jars (don't reveal what is in the jars yet):

A Vinegar (2)
B Baking Soda (9)
C Tap Water (7)
D Diet 7-up and Distilled Water (4)
E Tap Water with cinnamon and mint leaves (7)

Today we are going to analyze some substances. They are all safe.

Handout Lab Worksheet (Explain that we need to make a prediction before we start – scientists will formulate a hypothesis)

In front of me and at your station there are 5 jars. Do they all look the same? Do they all look like water? What if I told you only one of these jars contains ONLY tap water? Would that surprise you? If you were to guess, which jar do you think contains ONLY tap water? **FILL IN YOUR PREDICTION ON YOUR LAB SHEET**

How can we figure this out? We need to gather more evidence. One method scientists use to figure something like this out is to eliminate possibilities based on observational evidence. One way we observe is by using our eyes. Using your sight, look for anything in these samples that would lead you to believe it contains something other than just water? (they should choose the one with cinnamon and mint leaves) **Have them fill in their lab sheets for the Appearance column.**

Ok, we've ruled one out, but have 4 left. What is another way we could figure out which one contains ONLY tap water. (if they come up with tasting it, then discus that tasting a sample in NOT an acceptable scientific or healthy practice. Scientists do not taste their experiments).

Hopefully someone comes up with smelling it. However, scientists are safety conscious and know that putting something up to your nose and smelling it could be dangerous. Scientists use a method called "wafting" when they want to smell something. Demonstrate by opening one jar and fanning the scent toward your nose. Then have each station open their "A" jar and do the same. **Have them fill in their lab sheets for the Odor column.**

Once everyone is done with that….explain (but don't reveal substances yet):
sample A had a smell that you didn't like but couldn't really see.
Sample B had a substance you really couldn't smell or see .
Sample C you couldn't smell or see.
Sample D You could smell something, but not see it.
Sample E had a smell that most of you did like and it was easy to see.

Now knowing this . . . which of the samples would you say are "clean?" Allow the students to discuss. All will agree that sample C (tap water) is "clean "and most will say that the other 4 are not because they have something in them they smelled or saw.

BUT you didn't see or smell anything in sample B (baking soda) so why isn't it clean? You can reveal that sample E is water, cinnamon, and mint. Don't we eat cinnamon and mint? Just because they created a smell and we could see them in the water, does that really make the water "unclean?" (Answers will vary but the students may still be concerned that something is in the water, even if it isn't harmful)

The word "clean" doesn't really seem to work in this situation, does it? Maybe we should use a different word. What are some words that might fit this situation? (Allow the students the opportunity to brainstorm. Answers will vary but ultimately they will say things like "safe to drink" or "healthy" or possibly "unsafe to drink" or "unhealthy.") Exactly!! You are so correct. It really isn't about what is or is not "clean," but rather about what is or is not "safe" and/or "healthy."

Sight and smell alone cannot help us determine whether a body of water is actually safe to drink or healthy for organisms to live in.

Take a look at these 2 jars. (FLOC control & FLOC test jars). This is the reason you do not fill up your canteen with river or lake water without purifying it first. There are many things your eyes can not see in a jar of stream or lake water. These are the things could possibly make us sick, like bacteria.

Therefore, something else we can do is run some tests on the sample. Water resource scientists collect water samples and run tests to ensure lakes, rivers, streams, and even drinking water is safe and healthy for us and the other organisms that live there. Some water tests can easily be done with water testing equipment (meters, thermometers, etc) or test strips or tabs. Other more complicated tests are sent to health laboratories.

Today we are going to learn about one type of water test – the pH test.

Just like this water (point to the 5 jars), it may look clear, but you have no idea if there are any other substances in it, unless you test it. **Hand out pH Scale to each student**.

- Explain to students that all liquids have a pH level. pH is a measure of how much hydrogen, in an ionic form, is in a solution. pH (the power of Hydrogen) is an indicator of water acidity or alkalinity. Use poster to explain most acidic to most basic and neutral.
- It ranges from 1 – 14. Any product with a measure of less than 7 is considered an acid while anything greater than 7 is alkaline or basic. Products with a measure of 7 are considered neutral.
- The pH scale is a "power of ten" (or logarithmic) scale. So each one-digit change in the scale indicates a ten-fold change in acidity or alkalinity. In other words, a substance with a pH of 3 is 10 times more acidic than a substance with a pH of 4; 100 times more acidic than a substance with a pH of 5, and 10,000 times more acidic than a substance that is neutral. (this can work backwards, too, as substances become more basic)

There are several techniques used to measure pH. Litmus paper or pH paper is commonly used when the measurements do not need to be highly accurate. pH meters are used when accurate measurements are needed.

Demonstrate how to conduct a pH test and how to read the results. Emphasize that the box of pH strips must be kept dry. Suggest one person hold the box while another does the test.

Have each group work with the samples at their table. Each person should have a turn taking pH measurements. Have each group put the samples in order from most acidic on the left to most basic on the right, using their pH handout.

When sufficient time has passed, ask by group, which jar (from acid to base) is 1st, 2nd, 3rd, etc and write the results on the board.

Answer should be: A… D… C/E…. B

Conclusion

Thinking back to what we discussed about water being the universal solvent and substances dissolving into it - Do you think the samples you investigated today may have substances in them that you can't see or smell? Or sometimes see but not smell? Or sometimes smell but not see? Allow the students to respond.

Do you feel confident in your results? Do you think you have gathered enough evidence to be really certain that the sample you selected a "Tap Water Only" sample is really water only? **FILL IN YOUR CONCLUSION ON YOUR LAB SHEET** Which jar does everyone think have Water Only in it? Maybe, but if this sample were to be for drinking, are you certain it is safe and healthy? No. To be sure it would be clean enough or healthy enough to drink, more lab tests would need to be done to make sure other things you cannot see, like bacteria or nitrates, are not in the water. Just like the water we drink, scientists study lakes and streams to make sure the water is healthy enough for all the things that live there.

"clear"doesn't always mean "clean" and it doesn't always mean "healthy."

(You can reveal what each jar contained)

Thank everyone for participating, compliment behavior and answer any questions the students may still have.

SET UP FOR NEXT SESSION

Adapted from http://trinityrivertexas.org/

FINAL CLEAN UP

Approximately 30 minutes

- Replace all instructions in folder
- Rinse out each glass jar and thoroughly dry. Place in storage container
- Return all unused supplies to storage container
- Place presenter instructions, poster, and unused student handouts in storage container