WATER HEROES 2014 – SCIENCE U – INSTRUCTOR BOOKLET

PRE-CAMP ACTIVITY

Before arriving at camp, the campers should calculate how much water their family uses per day (http://www.gracelinks.org/3404/water-footprint-calculator). The purpose of this activity is to make the students aware of how much water they consume on and how they take clean water for granted.

MONDAY: HOW CAN WATER BE CONTAMINANTED AND WHAT CAN WE DO ABOUT IT?

Camp Arrival and Check-in (8:30 – 9:00) – Chemistry 102

Students will arrive with their parents to registration. At the registration desk, they will receive their notebooks and water bottles. The water bottles will be color coded according to the team (6 teams – five students each. *It may be only five teams because we only have 25 campers at this point*). The team colors will be based on what water bottle colors we can get.

Opening Ceremony (9:00) – Chemistry 102

- Opening Statement from Mike Zeman.
- All instructors will introduce themselves. We will explain why we are doing this camp and what we hope to accomplish with the campers.
- Review water budget and give/review the quiz on water usage and contamination. (Stephanie)
- Do pre-assessment quiz. (Stephanie)
- Explain why we are using re-usable bottles. (Rachel)
- Break them into groups based on their water bottle colors. Have them go outside to decorate the bottles, meet their team members, and fill up the water bottles.
- Say goodbye to parents and head to Whitmore lab to clean up dirty water.

Water Survey: How much do you know about the water that you drink?

1. Approximately what percentage of plastic water bottles actually get recycled in the USA?
   A. 5%
   B. 15%
   C. 30%
   D. 60%

2. Is it safe to pee in a swimming pool?
   A. Yes
   B. No

3. Which material is best at removing organic chemicals from water?
   A. Charcoal
   B. Sand
   C. Gravel
   D. Limestone

4. What is inside a Brita water filter?
   A. Sand
   B. Tiny plastic beads
   C. Metal foil
   D. Activated carbon

5. Which organisms are responsible for the majority of treatment at wastewater treatment plants?
   A. Algae
   B. Bacteria
   C. Fungi
   D. Macroinvertebrates
   E. Plants

6. Which organisms help clean wastewater in Eco-Machines?
    A. Algae
    B. Bacteria
    C. Fungi
    D. Macroinvertebrates
    E. Plants
    F. A and B
    G. C and D
    H. All of the above

7. A healthy stream has lots of macroinvertebrates.
    A. True
    B. False

8. Concrete-lined channels help keep water in streams clean.
    A. True
    B. False

9. Which of the following is an endocrine disrupting chemical commonly found in antimicrobial soaps, some toothpastes, and products containing Microban?
    A. Actinomycin
    B. Bactine
    C. Pthalate
    D. Triclosan

10. Which of the following is an endocrine disrupting chemical commonly found in plastic water bottles and perfumes?
    A. Actinomycin
    B. Bactine
    C. Pthalate
    D. Triclosan

11. What should you NEVER do with expired medications?
    A. Throw them in the trash.
    B. Flush them down the toilet.
    C. Leave them in their original bottle and return them to a pharmacy.

Hands-on Water Treatment (9:30 – 12:00 w/ snack break) – Whitmore Lab 105B

Purpose:

1. Introduce campers to different types of water pollution.
2. Introduce campers to different types of materials that can be used to remediate water.
3. Have students develop a scientific approach to determine what materials are appropriate for each type of contaminated water.

Materials Needed:

- Six Buchner funnels and flasks
- Paper towels
- Cups or scoops for materials
- Package of coffee filters
- Gravel
- Sand
- Activated Carbon
- Limestone pieces (small pieces, but not powder)
- Conductivity meter
- Turbidimeter
- pH paper
- Waste bucket for water
- Table salt (to make saline water)
- Fluorescent bacteria
- Dirt (to make dirty water)
- Acid for water (HCl)
- Methylene blue stock (10 g/L)
- Gloves and Safety glasses
- Small beakers for groups to transport water with (several – at least 6)
- Five large beakers (>2L) for making the contaminated waters
- Five stir plates and stir bars (if available, not necessary)

Prep:

- Setup six stations in the laboratory – one for each group. Each station will need:

- One Buchner funnel and flask
- Paper towels
- Filter materials: charcoal, sand, gravel, several coffee filters, limestone (each in a small disposable container – enough to make a few filters worth). Prepare one to be a demo set that we can use while explaining the situation.
- 5 packs of pH paper
- Small beaker to transport water with.

- Fill the five large beakers (2L each) with tap water (*do not add contaminants yet*). Label the beakers: (1) muddy water, (2) acidic water, (3) salty water, (4) chemically contaminated water, (5) bacteria contaminated water. If possible, have the waters on stir plates with stir bars.
- Setup conductivity meter.

Introduction:

Imagine that you are out camping and you get stranded. You need clean water to drink, but all the water you can find is unsafe to drink for different reasons. (Make the five waters in front of the students – pour dirt (Arizona Fine Dust) into 1, pour “acid” into 2 (we will use vinegar), pour salt into 3 (3 g/L), pour methylene blue into 4 (determine amount), pour bacteria into 5.

To make matters worse, you only have limited options to try to purify the water – materials you might expect to find at a campsite. (Show them the materials they have available.)

Before we try to clean up these waters, we need to know how we will “know” if the water is clean. We don’t want to drink the water to check because if it’s still contaminated we will get sick. Ask for volunteers for how we will check each one:

Water	**How will we know if we purified the water?**
1. Muddy Water	*we can check it visually and with turbidimeter*
2. Acidic Water	*we need to check the pH (pH paper)*
3. Salty Water	*we need to know how salty it is (conductivity)*

4. Chemically Contaminated Water	*visually*
5. Bacteria Contaminated Water	*visually (fluorescent bacteria).*

In their notebooks, have them fill in the column on the right.

Now we will break into groups and each group will try to determine how we can remediate each water sample using the materials we have.

Question: How do we determine what filter materials will remove each contaminant?

Our Approach: *(Have them explain in words how they will answer this question – goal is to systematically go through the different filter materials).*

To determine the materials that can be used to remediate each water, we will …

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Hypotheses: What do you expect will clean up each water?

Water	**Material(s)**
1. Muddy Water	

2. Acidic Water	
3. Salty Water	
4. Chemically Contaminated Water	
5. Bacteria Contaminated Water	

Results:

1. Muddy Water

Material(s)	Result

Conclusions:

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2. Acidic Water

Material(s)	Result

Conclusions:

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3. Salty Water

Material(s)	Result

Conclusions:

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4. Chemically Contaminated Water

Material(s)	Result

Conclusions:

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5. Biologically Contaminated Water

Material(s)	Result

Conclusions:

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______

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______

Discussion. How would you recommend treating each type of water?

1. Muddy: ____

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______

2. Acidic: ____

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______

3. Salty: ____

____
______

4. Chemical: ____

____

5. Bacteria: ____

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Lunch Activity (1:00) – Tasting Lemonade with different salt contents – Outside

To make: 0.5 g/L solution (1L), 1.0 g/L solution (1L), 2.0 g/L (0.5L), 10 g/L (0.5L), 35 g/L (0.5L)

How salty is salty? You measured salinity using conductivity, more salt conducts more electricity and thus "conductivity" can be used to measure salt content. You also have a salt meter – your tongue. We have made several concentrations of salt in lemonade for you. Guess what salinity these are (connect lines between sample numbers and the right concentrations.? Also write down the conductivities measured

Conductivity

Sample 1 35 g/L (seawater!)

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Sample 2 0.5 g/L (~tap water)

____

Sample 3 1.0 g/L

____

Sample 4 2.0 g/L

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Sample 5 10 g/L

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Which lemonade tasted the best to you?

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State of the Art Water Treatment (1:30 - 3:30 w/snack) – Whitmore Lab 105B

Begin with discussion: there are various technologies used to treat water that we encounter everyday. Briefly demonstrate each technology and see if the students have heard of them:

1. Brita filters (Activated Carbon)
2. Life Straw (Membrane filtration)
3. Reverse Osmosis (Tiny holes)
4. Camping Filter
5. Lime

Each will be opened up to demonstrate how it works and what materials it uses. With a working model we will do a small demonstration of each one and we will have a non-working version with the filters sliced in half (for Brita, Lifestraw and the camping filter).

Technology	**Materials inside**
Brita Filter	
Life Straw	
Reverse Osmosis	
Camping Filter	

Lime	

Hypotheses:

What contaminants would the Brita Filter remove? Why?

My hypothesis is that ____

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What contaminant does the Life Straw remove? Why?

My hypothesis is that ____

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What contaminants does Reverse Osmosis remove? Why?

My hypothesis is that ____

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What contaminants does the Camping Filter remove? Why?

My hypothesis is that ____

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What contaminants does the lime remove? Why?

My hypothesis is that ____

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Materials Needed:

- 2 Brita Pitchers
- 2 Life straws
- Lime
- RO Membranes and Setup
- 2 Camping filter

Water Recipes (make during break)

(1) muddy water – (6 L) Add Arizona Fine dust to make up to a turbidity of 20 NTU

(2) acidic water – (6 L) Add HCl to make up to a pH of 4.0

(3) salty water – (6L) Add 18 g of salt to 6 L to make 3g/L water

(4) chemically contaminated water– (6 L) Add 10 mg of methylene blue to 6 L water

(5) bacteria contaminated water – Add enough bacteria to 6 L to cause a change in color. Use of a laser pointer (green) will also get a fluorescent response in here

Grouping: Send a person from each group to work on one technology and to learn about it. On each technology work with the new group and your mentor to test all waters to see if the technology worked for the water you used and write down your observations. Feel free to move among the different technologies when you have a break to learn about the other techniques.

Results:

Brita Filter:

Water	Result
1. Muddy Water	
2. Acidic Water	
3. Salty Water	
4. Chemically Contaminated Water	
5. Bacteria Contaminated Water	

Life Straw:

Water	Result
1. Muddy Water	
2. Acidic Water	
3. Salty Water	
4. Chemically Contaminated Water	
5. Bacteria Contaminated Water	

Reverse Osmosis:

Water	Result
1. Muddy Water	
2. Acidic Water	
3. Salty Water	
4. Chemically Contaminated Water	
5. Bacteria Contaminated Water	

Camping Filter:

Water	Result
1. Muddy Water	
2. Acidic Water	
3. Salty Water	
4. Chemically Contaminated Water	
5. Bacteria Contaminated Water	

Lime:

Water	Result
1. Muddy Water	
2. Acidic Water	
3. Salty Water	
4. Chemically Contaminated Water	
5. Bacteria Contaminated Water	

Discussion: Why do you think that happened? *If all the contaminants were mixed together, how would you treat all the water, which process will you use in what order and why?*

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Conclusions and Recommendations:

List the best technology to remove each contaminant:

Water	Preferred technology
1. Muddy Water	
2. Acidic Water	
3. Salty Water	
4. Chemically Contaminated Water	
5. Bacteria Contaminated Water	

What is the order of treating contaminated water if it has particles, bacteria, chemicals and salt?

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How would you "scale-up" these processes to treat enough water for 50,000 people per day?

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TUESDAY: WASTEWATER TREATMENT

Morning Activity (9:00 – 12:00 field trip w/ snack break) – start in Chemistry 102

Yesterday we talked about many ways that water can be contaminated.

What were some of the contaminants that you removed yesterday?

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Today we are going to talk about how we treat the water that goes down the drain. This water needs to be treated so it can be released safely into streams and rivers.

Here is sample of wastewater. What kinds of contaminants might be in there? Where would they come from? Is the contaminant harmful? If so, what effects might it have?

Contaminant and source	*What are negative effects?*	*How would you remove it?*

A conventional wastewater treatment plant contains the following operations:

Activated sludge tank:

Microorganisms consume the "food" (mostly organic matter) in the water. Oxygen is constantly bubbled into the tank.

http://upload.wikimedia.org/wikipedia/commons/6/6e/Beckton_STP,_Activated_Sludge_Tank_-_geograph.org.uk_-_1481906.jpg\

Clarifier:

Solid particles and microbes are given time to settle. These particles are removed from the bottom of the tank as sludge.

http://www.trivenigroup.com/images/circular-clarfier.jpg

Screens and grit chamber:

Large particles (> ½ inch) and grit are physically removed to protect equipment and pumps. http://www.ci.beloit.wi.us/vertical/Sites/

Chlorination contact tank:

Chlorine is added to inactivate microbes. (Be careful – chlorine can also react with organic matter.)

http://www.johnstown-redevelopment.org/RAW/WWTP%2011.jpg

Put these in order based on what you would find in a wastewater treatment plant.

What contaminants are not removed by these tanks? How would you remove these?

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Ecological Wastewater Treatment – The Eco-Machine^{TM}

An Eco-Machine is an alternative to conventional wastewater treatment that uses an ecosystem of algae, bacteria, plants, snails, and even fish to clean the water. The main advantages of this system are that it uses no chemicals, produces very little sludge, and uses much less energy than conventional wastewater treatment plants. Eco-Machines are best for treating wastewater for small communities, and are particularly useful in developing countries, where wastewater infrastructure (sewer pipes and treatment plants) do not exist.

Here is a picture of the Penn State Eco-Machine that we will visit today:

What do you notice in the picture that is different from a conventional wastewater treatment plant? What do you think it will be like to visit it? Do you think it will smell good or bad?

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Ecosystems in nature recycle energy and nutrients through a food chain. One flow of energy and nutrients in the Penn State Eco-Machine system follows this basic pathway:

Bacteria → Algae + Duckweed → Snails + Zooplankton → Fish

In the pathway described above, how do each of the organisms help clean the water?

Bacteria:
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Algae + Duckweed:
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Snails + Zooplankton:
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Fish:
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What unique roll do the plants play in this system?

Plants:

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Snacking on biological foods (1:00) – Outside

Snacks with bugs – yogurt, cheese, bread, apple cider

Looking at microorganisms under the microscope (1:30 – 3:30 w/ snack break) – Whitmore Lab 105B

<u>The Question</u>: *How do microorganisms help clean wastewater?*

<u>Introduction and Background</u>: Microorganisms make up more than 60% of life on Earth, and we could not live without them. They benefit humans in many ways, and can be used to make food, produce medicines, breakdown toxic wastes. Although some microorganisms are pathogens and can make people sick, the majority are friendly. In nature, many types of microorganisms work together in complex ecosystems to keep the environment clean. Algae, archaea, bacteria, fungi, and protozoa all have roles to play. Generally, the more diverse a microbial community is, the better it can clean the environment. Do you think this is also true when cleaning up wastewater?

<u>Hypothesis</u>: *What kinds of microorganisms help clean wastewater? How do they do it? How are the numbers and varieties of microorganisms different in different treatment systems (for example, between a conventional wastewater treatment plant vs. an Eco-Machine)?*

My hypothesis is:____

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______

Materials and Methods:
Upon arrival in the lab, Dr. Brennan will review the proper use of microscopes, and discuss the different samples that are available for viewing. A few important things to remember when working with microscopes:

1. ALWAYS start observations on any new slide with the lowest power objective (10X).
2. ALWAYS return the microscope to the lowest power objective when done observing anything and before putting the microscope away.
3. Begin new observations with the condenser as close to the stage as possible.

4. Use the lowest voltage and keep the diaphragm as closed as possible to preserve bulb life and to prevent overheating the samples.

Divide into your groups. Each group will need the following equipment:

- Microscope
- Microscope slides and cover slips
- Immersion oil & lens paper
- Wastewater samples from the wastewater treatment plant and the Eco-Machine
- Pipet or eye-dropper
- 6% $MgCl_2$ anesthetic (73.2 mg/L), only if microorganisms are moving too quickly

For each water sample, complete the following:

1. Prepare a wet mount slide. Using an eye-dropper or pipet, place a very small drop of wastewater that contains visible suspended material onto a clean glass slide. Gently place a coverslip over the drop. Make sure the amount of liquid on the slide does not run out from the coverslip. Wipe up any excess liquid with a Kimwipe.
2. First, observe the slide with the 10X objective to center your sample, get the microscope in focus, and distinguish the forms of various organisms.
3. When you have located an interesting organism or group of organisms, switch to the 40X objective and examine them in close detail.
    a. If your slide doesn't seem to have many organisms, make a new one.
    b. If the organisms are moving too fast to observe them clearly, add a few drops of the $MgCl_2$ solution to a subsample, wait 5 minutes, and prepare a new slide.

Results:

Make a sketch of the organisms that you observe on the supplied worksheet, and note any observations (motility, relative dominance, etc.). Change your field of view and see if you can find examples of different microorganisms in each sample. Sketch them on the worksheet. If you want an even closer view of smaller organisms, add a drop of immersion oil on the slide and switch to the 100X objective.

Identify the organisms you have sketched by matching them to pictures of common organisms in the supplied reference material. For additional help, search within the pages and links at "A Virtual Pond Dip" http://www.microscopy-uk.org.uk/ponddip/.

Microscopy Worksheet

Source water sample ID: Wastewater Treatment Plant

List of organisms observed :

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Sketches of Organisms:

Other observations:

Microscopy Worksheet

Source water sample ID: Eco-Machine

List of organisms observed :

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Sketches of Organisms:

Other observations:

Discussion:

Discuss and compare the organisms that you observed from each sample. What similarities and differences did you see in the organisms collected from different locations? What inferences can you make with regard to the water quality of the treatment systems?

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Conclusions and Recommendations:

What did you learn? How do you think different microorganisms contribute to wastewater treatment?

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WEDNESDAY: ARE THE PENN STATE POOLS SAFE?

Measuring Chlorine in Pools (9:00 – 11:00) – Various locations, start in 102 Chemistry

The question: *What would make the swimming pools unsafe to swim in?*

Yesterday we heard about the good microorganisms that end up in our food and help us clean up wastewater. Today we will talk about how to protect people from spreading disease in a swimming pool.

All of us carry microbes on our body and these are released in the pool when we swim. Some of these microbes are good (like we learned yesterday) and some will cause people to get sick.

What do we add to pools to kill the microbes? _________________________

We protect people from getting sick from these germs by adding "chlorine" (usually in the form of bleach) to the pool. What we know as "chlorine" is actually a chemical called hypochlorous acid (HOCl) and it kills the microbes so that people can safety swim in the pool. Chlorine works great to kill microbes as long as it remains in the form HOCl. We can measure the amount of free chlorine in pools.

Free chlorine = amount of chlorine in the form HOCl and OCl^-.

How high should the free chlorine be in pools? _______________________

What is the pH and why do we care for pools?

pH is a measure of the concentration of hydrogen ions (H^+) and hydroxide ions (OH^-) in the water.

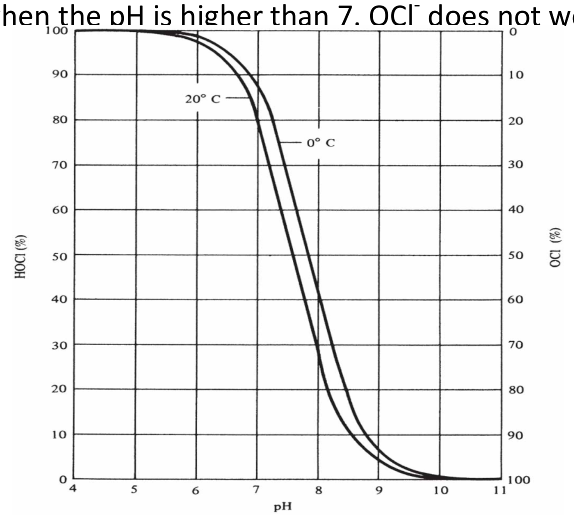
1/10,000,000	14	Liquid drain cleaner, Caustic soda
1/1,000,000	13	bleaches, oven cleaner
1/100,000	12	Soapy water
1/10,000	11	Household Ammonia (11.9)
1/1,000	10	Milk of magnesium (10.5)
1/100	9	Toothpaste (9.9)
1/10	8	Baking soda (8.4), Seawater, Eggs
0	7	"Pure" water (7)
10	6	Urine (6) Milk (6.6)
100	5	Acid rain (5.6) Black coffee (5)
1,000	4	Tomato juice (4.1)
10,000	3	Grapefruit & Orange juice, Soft drink
100,000	2	Lemon juice (2.3) Vinegar (2.9)
1,000,000	1	Hydrochloric acid secreted from the stomach lining (1)
10,000,000	0	Battery Acid

What is the pH of our bodies?

What do you think should be the pH in swimming pools?

http://2009rt8sciafifa.files.wordpress.com/2010/03/ph_scale.jpg

There is one more reason why we should care about the pH of the water:
HOCl turns into OCl^- when the pH is higher than 7. OCl^- does not work as well as HOCl.



What is the ideal pH for pools?

What is the minimum amount of free chlorine in a pool?

What is the maximum amount of free chlorine in a pool?

Materials and Methods:

Chlorinated pool water
pH meter and pH paper
Chlorine detection kits

Hypothesis: Do you think the pools are within the acceptable pH range and free chlorine range?

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Results:

Sample description	*pH*	*Free chlorine*	*% of chlorine as HOCl (see graph)*

Discussion:
Which samples were safe in terms of both the free chlorine and the pH?

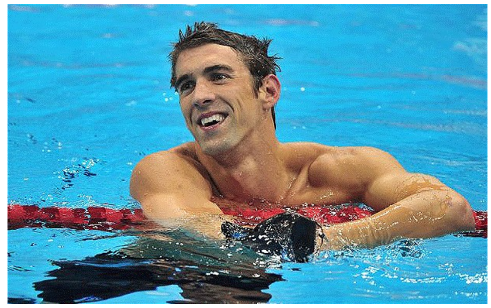
Why is it important that there is still chlorine in the water when it comes into your home (or a water fountain)?

Conclusions and Recommendations:

Should you pee in a pool? (11:00 – 12:00) – Whitmore Lab 105B

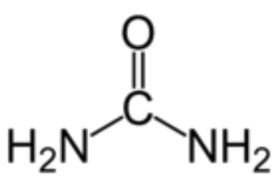
This US swimmer said: "I think everybody pees in the pool. It's kind of a normal thing to do for swimmers. When we're in the water for two hours, we don't really get out to pee.

"Chlorine kills it so it's not bad."

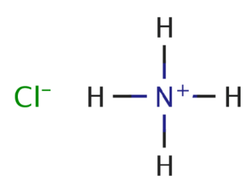


What do you think? What is the harm of peeing in the pool?

Urea is found in both sweat and urine and can be dissolved in water. It can be converted to many other nitrogen compounds including ammonium chloride.



(urea)



(Ammonium chloride)

Every time you pee in a pool you release approximately 4 grams of urea.

If you are sweating in the pool (from swimming a race) you might release anywhere from 0.4 – 4 grams of urea!

In the last experience we determined that safe pools have at least 0.5 mg/L free chlorine with a pH between 6.8 and 7.8. It turns out that compounds containing nitrogen will react with chlorine and reduce the free chlorine available to disinfect microorganisms. In this experience we will measure how much chlorine is reduced when there is nitrogen in pool water (like when you pee in a pool).

Hypotheses:

What do you think will happen to the pH and the free available chlorine when the nitrogen is added to chlorinated water?

My hypothesis is that:

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Materials and Methods

1. First we made the chlorinated water by adding 0.036 mL of bleach (8.25% OCl^-) to 1 liter of water. This should make approximately 3 mg/L free chlorine.

the Test into 2 small tubes (the first scored line on the tube is 5 mL). Add the Free Chlorine "pillow" to the first tube and the Total Chlorine "pillow" to the second tube. Cap the tubes and shake for 30 seconds. Use the chlorine wheel to determine the free and total chlorine in each test sample.

Results:

Sample #	mL of ammonium chlorine solution	Free chlorine		Total chlorine	
Control	0				
Test					
(Other group)					

Which volume of ammonium chloride causes the chlorine to fall below a safe concentration?

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There may be some error in your measurement. List all the possibly ways that error could have been introduced in your experiment.

Conclusions:

If you were working as a lifeguard at a pool and the manager asked you to measure the chlorine concentration in the pool, would you measure "free chlorine" or "total chlorine"? Explain your answer.

Why is it important to shower before entering the pool?

THURSDAY: WATER IN NATURAL ENVIRONMENTS

Morning Activity (9:00 – 11:30) – Natural waterways in the Spring Creek Watershed at the Arboretum, Penn State, PA

<u>The question</u>: *How many miles of natural waterways are in the Spring Creek Watershed?*

<u>Background</u>: Did you know that some of the water that flows past Harrisburg in the Susquehanna River begins to flow at Penn State? This means that you could travel to Harrisburg from Penn State by water. If you travel to Harrisburg by car, it is 90 miles away (1.5 hours). Today we will plan a journey to Harrisburg by waterway instead of roadway. We will start from the smallest creeks in the Spring Creek Watershed.

<u>Hypothesis</u>: *How do natural waterways begin? Where do natural waterways from Nittany Valley travel to before and after Harrisburg (indicate on map if you can)? And how many miles of water are in Spring Creek?*

My hypothesis is: ____

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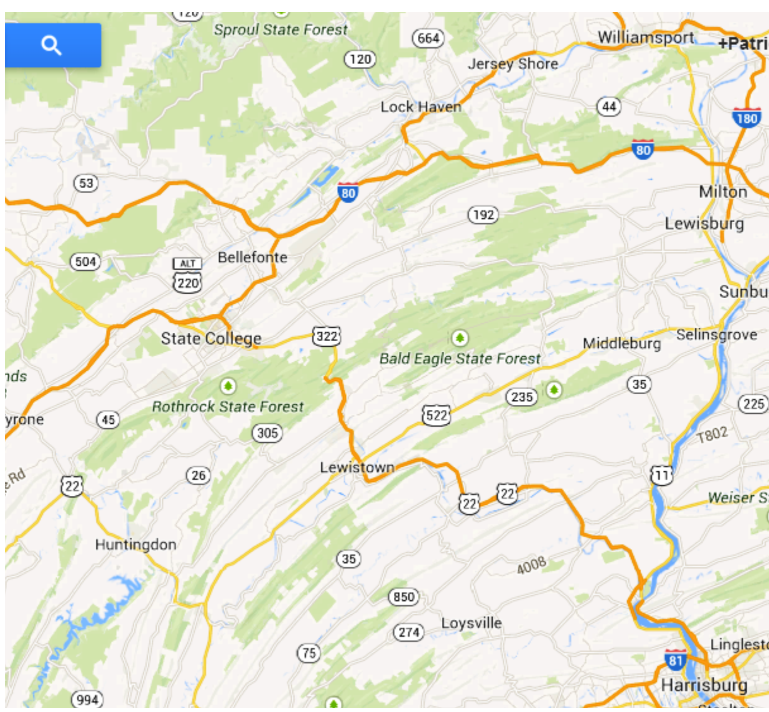
Guess the route of natural water flow from Penn State to Harrisburg. Also show how you would go by car:



Materials

- 1 ruler per group
- A 5 Gallon Bucket of water (hose spigot is between the map and the pavilion) and a Dixie cup for each student
- 1 calculator per group
- 1 highlighter or marker per student

Approach

1. Obtain a sense of distance

Go to the Arboretum and stand by the bike rack. Estimate the distance between yourself and the top of Mt. Nittany. (4 miles)

My hypothesis is:
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2. Determine why and where water flows in the Spring Creek Watershed

i) Go to the Arboretum pavilion stone map and determine which way water flows and where it ends up. Where and how do natural waterways begin?

ii) Use water and the small cups provided to fill the tributaries of Spring Creek on the map!

3. Measure the waterways in the Spring Creek Watershed

i) Use a ruler to measure the length of the waterways on the map. There are many waterways. The chart below will help you organize your measurements (measure in any order you like).

Waterway	Distance (cm)
Logan Branch	
Irish Hollow Run	
Buffalo Run	
Big Hollow	
Slab Cabin Run	
Roaring Run	
Galbraith Gap Run	
Spring Creek	

ii) Add the distances together to find the total length…

iii) Scale your results to life size. The map scale is 1 cm = 0.023 km (1 inch = 0.036 miles)

<u>Discussion:</u> Look at the map of Pennsylvania above. Correctly highlight the way water travels from State College to Harrisburg. On both the stone map and the highlighted map, it is easy to see that water does not travel in a straight path toward its destination. Propose ideas on why this happens. How does water end up in natural water ways?

Lunch: Picnic at Spring Creek Park (12:00 – 1:30)

Aquatic Macroinvertebrate Collection (1:30 – 3:30) - at Spring Creek Park, Houserville, PA

The Question: *What does the presence of macroinvertebrates indicate about water quality?*

Introduction and Background: Macroinvertebrates are small animals that have no backbone that you can see with the naked eye. These include insects, crustaceans, molluscs, arachnids, and annelids (segmented worms). Aquatic macroinvertebrates live in the water for part or all of their lives, and some are more sensitive to chemical and physical conditions in the water than others. For example, caddisflies, mayflies, and stoneflies are aquatic insects known to be increasingly sensitive to chemical pollution (in that order), and therefore are good indicators of water quality. Healthy streams generally have a high diversity of macroinvertebrates and have several of these types of insects.

Hypothesis: *What kinds of macroinvertebrates do you expect to find in Spring Creek? What is it about the environment around Spring Creek that makes it a good or bad habitat for stream life?*

My hypothesis is: ____

____
______

Materials and Methods:

1. Put your water shoes on, and receive a tutorial on the proper use of the D-frame kick nets and other macroinvertebrate sampling equipment.

2. Sample macroinvertebrates.
    a. Obtain a sample using the D-frame kick nets as demonstrated, and scrub rocks from the area sampled to enhance your sample.
    b. Place about 1” of water into a white pan and empty the contents of your net.
    c. Using the keys provided, try to identify the insects in your sample; calculate the water quality indices as described below.

3. Perform a Streamside Habitat Walk for ~300 ft of the stream reach you sampled using the EPA handouts (attached) as discussed.

Results:
Calculate water quality indices:

EPT value – this is the total number of species from the orders Ephemeroptera (Mayflies), Plecoptera (Stoneflies), and Trichoptera (Caddisflies) found in the sample (if possible, sort your sample into different species using differences in shape and color).

Number of Ephemeroptera (Mayflies):

Number of Plecoptera (Stoneflies):

Number of Trichoptera (Caddisflies):

Count the total of all different <u>species</u> in these three groups combined. This is the EPT value. Score the EPT value as:

Excellent (>10) **Good (6 - 10)** **Fair (2 - 5)** **Poor (< 2)**

The simplified EPT has been developed for use with the Adopt-A-Stream program:

Excellent	Stoneflies, Mayflies, and Caddisflies present
Good	Mayflies and Caddisflies present; Stoneflies absent
Fair	Caddisflies present; Stoneflies and Mayflies absent
Poor	Stoneflies, Mayflies, and Caddisflies absent

Discussion: Discuss and compare the data that you collected during the lab. What do the macroinvertebrate results indicate about the water quality of Spring Creek? How does the Streamside Habitat Walk support (or refute) the findings of the macorinvertebrate survey?

Virtual exercise in stream restoration: Think about the different habitats that you observed in the stream. Now imagine that you are standing next to a stream whose bottom and sides have been replaced with concrete. Make a sketch on paper to illustrate how you would remake this concrete channel into a living stream. What structural and/or biological components would you add to increase microhabitat complexity (and hence the abundance of organisms)?

Emerging Contaminant Homework

The Question: *Are the chemicals in your personal care products safe?*

Introduction and Background: In the United States, the Food and Drug Administration (FDA) makes sure that the things we eat are safe. But are the personal care products that we put on our bodies safe? Every day, many people use shampoo, soap, deodorant, lotion, toothpaste, sunscreen, fragrance, and cosmetics that contain potentially harmful chemicals. After we use them on our bodies, many of these products are washed down the drain, where they travel through wastewater treatment plants, and ultimately back into the environment where they can harm aquatic life and even re-enter drinking water supplies. Although most of the ingredients in personal care products are safe, a handful have been shown to be potentially dangerous. In particular, **triclosan** (an antimicrobial agent found in some soaps, toothpastes, and deodorant), **parabens** (preservatives used in shampoos, lotions, and cosmetics), and **phthalates** (a plasticizer used in soft plastics, some fragrances, shampoo, cosmetics, and nail polish) are suspected endocrine disruptors, meaning that they may mimic or block natural hormones in our bodies. The effects of endocrine disruption range from reproductive problems to cancer, so it is best to avoid these chemicals, if possible.

Questions: *What kinds of chemicals are in the personal care products that you use every day? Which ones are potentially dangerous? Are there affordable alternatives which might be safer?*

Assignment:

1. In the Table below, common personal care products are provided in Column A. If you use additional products, add them to **Column A.**
2. **In Column B,** list the brand names of the personal care products that you use every day.

A	B	C	D	E
Product	**Brand Name**	**Hazard Score**	**Ingredients w/ score ≥ 5**	**Concerns (toxicity, contamination, etc.)**
Soap				
Shampoo				
Conditioner				
Deodorant				
Lotion				
Toothpaste				
Sunscreen				
Chapstick				
Fragrance				
Total	SUM =			

3. **Go to EWG's Skin Deep® database** at http://www.cosmeticsdatabase.com/ and enter the brand name of each of your products in the "Search more than 69,000 products" box, click "Search", and select your product from the search results.
   a. Record the "hazard score" of the product in **Column C** of the table.

   b. Click on either the hazard score or the product name to go to a page with more detailed information. Scroll down to the list of ingredients, record the chemical name of ingredients that have a score of "5" or higher in **Column D**, and summarize their corresponding concerns in **Column E**. Pay particular attention to the presence of triclosan, parabens (ethylparaben, methylparaben, propylparaben), and phthalates.

   c. **For the product with the highest hazard score, select a safer alternative that would be <u>easy</u> for you to switch to.** (You can find links to products with lower concerns by clicking on the product type in the top navigation bar.

This will take you to a list of similar products, which you can scroll through to find safer alternatives). **How does the substitution of this safer alternative reduce your total hazard score?**

4. **Discussion**. Was this assignment interesting, scary, etc.? Do you think it will actually make a difference in the personal care products you and your family use in the future?

FRIDAY: WHAT CAN YOU DO TO IMPROVE WATER QUALITY AND INFORM OTHERS?

***Manish* will lead bottled water discussion.**

Where does a majority of the bottled water produced come from? (Discussion)

A. Purified from tap water
B. Purified from crystal clear spring water
C. Fiji (A beautiful island in the pacific known for its heavenly water)
D. Ground and surface water sources

Is bottled water more tested or tap water to ensure that it is safe?

What are possible impurities in bottled water?

Can you list any harmful environmental impacts from using bottled water?

Make 2 lists on the board (or powerpoint presentation): The Pro's and Con's of Bottled Water

***Rachel* will lead emerging contaminant discussion (related to homework)**

***Stephanie* will lead developing world treatment.**

(End by 10:30)

Give water survey again.

Designing a water exhibition. (10:30 – 12:00; 1:30 – 3:00 w/ snack)

Now that you have learned a lot about how interact with water, we want you to teach it to others. Today you will be designing a prototype exhibit from **Discovery Space**, a hands-on science museum here in State College. It's possible that your idea will be implemented by Discovery Space and will become a future exhibit! Your goal is to create an exhibit idea, explain how it would work and what other students would learn from it, and develop a method to construct it. You will construct a poster to help illustrate your ideas.

Explain the rubric for what makes a good exhibit (included as a supplement).

Have person from Discovery Space explain what they look for in an exhibit.

Materials:
- Poster boards
- Paper
- Markers, pens, pencils

For Mentors:
The goal is that the campers will come up with an idea for an exhibit, explain what it would teach, and develop a plan for how they would construct it. Encourage them to brainstorm lots of ideas before starting on the poster itself. Towards the end of the time, have the students plan a presentation of their idea (a few minutes). Have them think about what they will say and who will say it.

Student Presentations for parents. (3:00 – 4:00)

Mike Zeman closing ceremony comments.

Have students make presentations with their posters (a few minutes). Encourage questions from the audience. Distribute awards to each group (decide on categories based on rubric):