Math/Science

West Sac Tap Out: Safe and Clean Drinking Water

Steve McNeil/Stonegate Grade Levels: Grade 7 August 2012

Lesson Overview: Students will overview and describe the treatment plant process from river water to clean drinking water. Students will test the pH of household liquids and test the chlorine content of water samples. Along the way students will calculate the volume of cylinders and calculate the weight of cubic feet of water. Then students will conduct a dirty water filtration experiment. Finally students will conduct and record a Water Survey and a Blind Taste Test using tap and bottled water samples to determine which one tastes best.

Materials Included in this Lesson

- Worksheets:
- Water Survey; Circle Area; Cylinder Volume; What's pH?; ; Water Treatment Plant Process; Dirty Water Filtration; Notes for pH.

Other Materials for this Lesson

- Plant power point: Pool test kit
- Household acids and bases (see Plan)
- Milk crate -1cu. ft.; 1 gal. plastic jug
- Aquarium Activated Carbon and Aquarium Gravel; 4 clear plastic cups
- Chlorine Shock Quick (3.99 for 1 lb.)
- Litmus paper (universal indicator)

Skills the Student will Learn

Student Deliverables

- Test and record: pH of liquids and chlorination of water samples
- The treatment process for safe drinking water
- Find volume of water basins (cylinders)
- Filtration methods for dirty water
- Record and Analyze Survey Results
- Description of treatment process
- Lab Write-ups: ; Dirty Water Filtration; What's pH?
- Circle Area Worksheet
- Cylinder Volume worksheet
- Survey Results poster
- Filtration and Chlorine Poster

Length of Lesson: X Days

Activity Day One

Show/explain Treatment Plant power point. Students fill in Process overview sheet.

Activity Day Two

Show cubic foot of water space(milk crate) and one gallon milk jug. Predict then explain that a gallon of water weighs 8.34 lbs. and a cubic foot of water is 7.48 gallons. So how much does one cubic foot of water weigh? (62.38 lbs.)
Review Area of a circle (A= pi r squared or A = diameter squared x 0.785) .
Explain and do Cylinder Volume worksheet.

Activity Day Three

Set up stations for pH testing of various liquids with litmus paper. Use pH notes to help students fill out top part of What's pH? As students rotate in groups to stations they record their findings on the bottom of the sheet. Possible liquids to test include white vinegar, hydrogen peroxide, unscented detergent, lemon and tomato juice, rubbing alcohol, tap water and distilled water. On The Class chart or butcher paper one person from each group can record findings so entire class results can be viewed. Students can then record the class mode and range for the pH of each liquid.

Activity Day Four/Five

Dirty water filtration : set up 4-6 plastic filtration cups with one or two layers of media in each cup. Layers can be made from Activated Carbon, aquarium gravel, and sand. I drilled three small holes in the bottom of the cups and put one Kleenex

inside to keep the media from falling through the bottom when the water seeps out. I measured equal amounts of dirt and water in 4 20 oz. Gatorade bottles and shook each one before pouring into the media filled cups. On paper students draw and label the 4 different media cups. Then they make predictions and record results of the filtration through each cup. Will the water be even clearer if water is filtered a second time? Why or why not? Students predict and record results. Students work in groups to make posters.
Students take Water Survey.

Activity Day 6

Use pool testing kit to test water samples. Pool water is recommended to have 2-4 ppm of chlorine. Use very small amounts of Shock Quick to make 4 samples of water at about 5 or 6 ppm. Students pretest the samples. Give 10 students tongue depressors and have them vigorously lick them. Then stick several of the sticks in each of the water samples. After 25 to 30 minutes post test the water samples. You can even have a few students spit in the containers to insure extra bacteria. Students make predictions and record the findings. Finally students use notes to make group posters recording the experiment and their findings.

Activity Day 7

Set up and do Blind Taste Test using 3 water samples: bottled water, tap water and distilled water. Then student results are tallied on Butcher paper. Do this with another class period(if possible) to increase the survey sample size. Students work in pairs to graph results and make a poster.

Activity Day Eight

Review Plant Power Point and discuss Treatment operator academic prerequisites: Chemistry and Algebra 1. Show Office of Water Programs web site.

Enrichment Suggestions

Include here any suggestions for extending this lesson.

Student Resources

The Office of Water Programs at Sacramento State offers water treatment operator training including entry level courses. www.owp.csus.edu/

Foundation Academic Standards

The following components are integral to the Energy and Utilities sector pathways: classroom, laboratory, hands-on contextual learning, project-and work-based instruction, internship, community classroom, cooperative career technical education, and leadership development. The Energy and Utilities sector standards prepare students for continued training, postsecondary education, or entry to a career.

FOUNDATION STANDARDS

1.0 Academics

Students understand the academic content required for entry into postsecondary education and employment in the Energy and Utilities sector.

1.1 Mathematics

Specific applications of Number Sense standards (grade seven):

(1.1) Read, write, and compare rational numbers in scientific notation (positive and negative powers of 10).

(1.2) Add, subtract, multiply, and divide rational numbers (integers, fractions, and terminating decimals).

Specific applications of Algebra and Functions standards (grade seven):

(1.1) Use variables and appropriate operations to write an expression or an equation.

Specific applications of Measurement and Geometry standards (grade seven):

(1.1) Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (e.g., miles per hour and feet per second.

(2.4) Relate the changes in measurement with a change of scale to the units used (e.g., square inches, cubic feet)

Specific applications of Measurement and Geometry standards (grade seven):

(1.1) Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (e.g., miles per hour and feet per second, cubic inches to cubic centimeters).

(2.4) Relate the changes in measurement with a change of scale to the units used (e.g., square inches, cubic feet) and to conversions between units (1 square foot = 144 square inches.

Specific applications of Mathematical Reasoning standards (grade seven):

(2.1) Use estimation to verify the reasonableness of calculated results.

(2.5) Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

CTE Pathway Standards

3.0 Career Planning and Management

Students understand how to make effective decisions, use career information, and manage personal career plans:

3.1 Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in careers.

3.2 Understand the scope of career opportunities and know the requirements for education, training, and licensure.

Lesson Plan Relevance To Externship

Everyone needs safe and clean drinking water. Math and science are needed to transform raw river water to drinking water. These lessons help explain and demonstrate how that happens. Students learn that water treatment is a viable career option.

Water Treatment Plant Process

Water Intake_____

_____

_____

_____

Coagulation_____

_____

Flocculation_____

_____

_____

_____

_____

Actiflo Process _____

_____

_____

_____

_____

Conventional Process_____

_____

_____

_____

Sedimentation_____

_____

_____

_____

_____

_____

Filtration_____

Chlorination_____

Clearwell_____

The pH scale is a way of measuring the acidity of a substance whether it be a base or an acid. The scale goes from one to fourteen. The smaller numbers are acids, the larger ones are bases, and the ones right around 7 are neutral.

Acids are substances that are higher up on the pH scale. They run from 1 to 6. One is the strongest acids, and six is the weakest. Another way to test substances is with litmus paper, if they turn the paper red then they are acidic. In addition to this acids are known for having a sour taste.

A caution, when working with substances in the lab, never stick anything in your mouth. Do not taste the substance to see if they are sour or bitter. Also when doing lab experiments with chemical, you should not stick anything near your face. This includes smelling, tasting, and looking.

Bases are substances that are located lower down on the pH scale. They run from 8 to 14. Eight is the weakest, and fourteen is the strongest acid there is. To see if a substance is a base, a litmus test may be done. If the test result are blue then the substance is a base. Bases feel soapy and slippery, and in addition to this they have a bitter taste. Have you ever gotten soap in you mouth? Soap is a base.

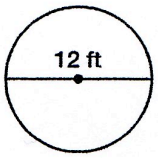
Neutral substances are those that fall right on the number seven on the pH scale. There are not very many substances that are commonly found to be neutral. The only one is pure water.

There is one more way to check the acidity of a substance and this its through litmus paper. If the litmus paper turns red then the substance is an acid, if it turns the paper blue then the substance is a base. The litmus test is a way to just test for acids and bases. It does not test the strength such as the pH does.

Name _____ Date _____

Algebra: Area of a Circle

Find the area of the circle.



Step 1: Find the radius of the circle.

The radius is $\frac{1}{2}$ the diameter.

$\frac{1}{2} \times 12 = 6$

The radius measures 6 ft.

Step 2: Use the formula.

$A = \pi r^2$

$= 3.14 \times 6^2$

$= 3.14 \times 36$

$= 113.04$

The area is 113.04 ft^2.

Find the area of each circle. Use 3.14 for π.

Alternate Area Formula:
$A = d^2 \times 0.785$

1. $r = 4$ cm _____

2. $r = 9$ m _____

3. $d = 20$ ft _____

4. $d = 27$ yd _____

5. $d = 30$ ft. _____

6. $r = 15$ ft _____

7. $d = 50$ ft. _____

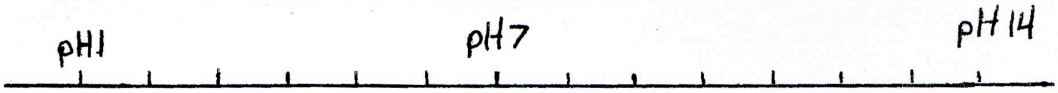
8. $r = 6$ yd. _____

9. $d = 12$ yd. _____

Name:_____
Period:_____

What's pH? How do we measure it?

Vocabulary:



pH scale

Acid

Base

Neutral

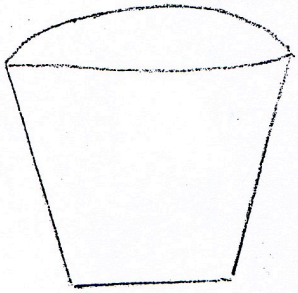
Indicator

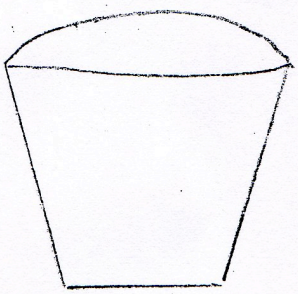
Cautions

Findings:

Dirty Water Filtration

Description:





Findings

Practice

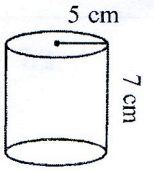
Reminder

The volume of a cylinder is computed by multiplying the height times the area of the base.

V = Base × h **V = h x πr²**

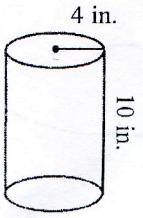
Directions: Compute the volume of each cylinder.

1.



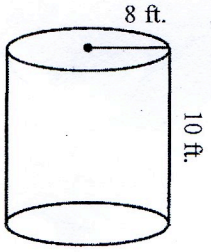
V = _____ cm^3

2.



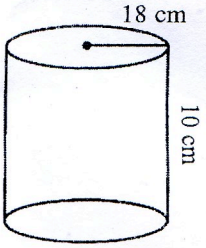
V = _____ $in.^3$

3.



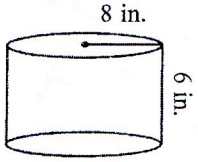
V = _____ $ft.^3$

4.



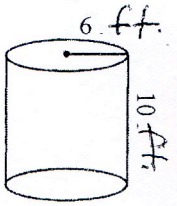
V = _____ cm^3

5.



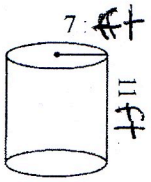
V = _____ $in.^3$

6.



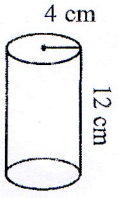
V = _____ ft^3

7.



V = _____ $ft.^3$

8.



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