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WATER CAREER PATHWAYS
Your Future is Clear.

TINY BUBBLES

TEACHER'S GUIDE

Napa Sanitation District

11/7/2017

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COVER SHEET

The Napa "Tiny Bubbles" Cover Sheet

Introduction: The following lessons introduces students to algebra equations in order to determine oxygen loading rates for an activated sludge system, conversion of a flow and concentration into pound and mathematic ratios.

Materials:

- Projector connected to a computer with internet to play video of incident
- Copies of each of the following:
    - Warm-Up and Exit Ticket
    - The Napa Shake up Worksheet
    - Applied Wastewater Math Formula Sheet and Conversion Factors
    - Student Surveys

Estimated Timeframe:

- 45 minutes to an hour, depending on how you spread and imbed your think time

Prior Knowledge/Skills Needed:

Before this application lesson, students must be able to:

- Calculate the result of an algebra equation using multiplication
- Calculate the result of one equation divided into another
- Calculate the ratio of one equation over another
- Conversion of a percentage to a decimal

Common Core State Standards:

CCSS.MATH.HS.A-CED.2: Create equations in two or more variables to represent relationships between quantities;

CCSS.MATH.HS.A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficient represented by letters.

Additional Common Core State Standards:

CCSS.MATH.HS.N-1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas;

CCSS.MATH.HS.A-CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

Implementation Suggestions:

- Ask students to think/write/pair/share often so students can verbalize and communicate their mathematics
- Students should do work on the board in groups or pairs

Accommodations/Modifications:

- For English Language Learners:
  - Be sure to have precise definitions of content vocabulary ready ahead of time.
  - Be sure to include think time when appropriate
  - Ask students to Think/Write/Share between for each question
- SPED/504:
  - Allow students to use a calculator for calculations
  - Allow students to use applied math formula sheet
  - Focus on having students verbalize the process in their own words
  - While students are finding solutions you may ask students for estimated solutions first, this helps students see if they are headed in the right direction with their answers

Extensions:

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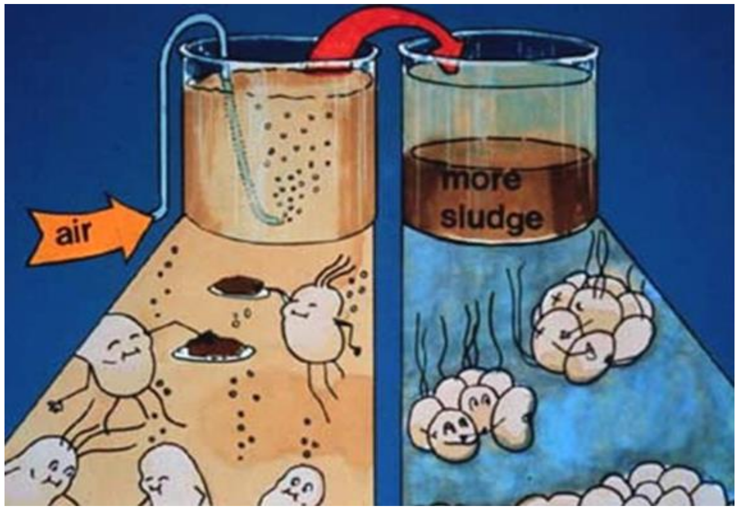
WARM-UP EXERCISE

Napa Tiny Bubbles Warm Up Exercise



1. There are 10 pounds of potatoes, a 20 pound Turkey, 3 pounds of green beans and 3 pounds of carrots ready for Sunday dinner. How many total pounds of food are available for Sunday dinner?
2. If there are 20 people coming for dinner what is the ratio of pounds of food per person?
3. If each person consumes (breathes) 2 pound of oxygen from the air while eating Sunday dinner what is the total pounds of oxygen consumed per pound of food eaten during dinner?

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VIDEO

Napa Sanitation “Tiny Bubbles” – Video

April 10, 2017

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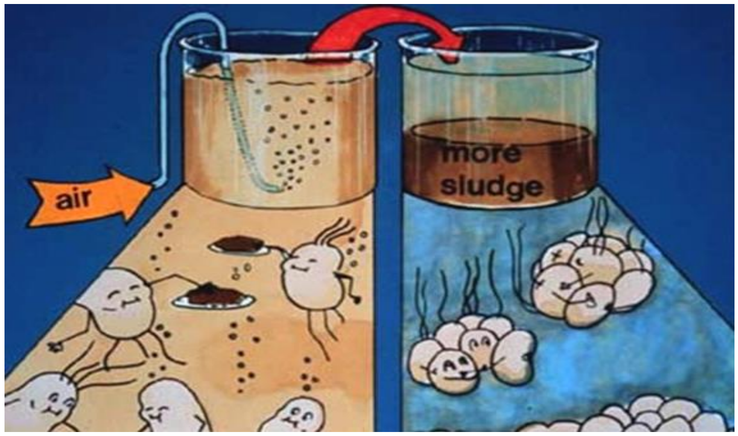
WORKSHEET

The Napa Tiny Bubbles Worksheet Sheet



Calculating oxygen requirement and organic loading are two important factors treatment plant operators have to understand in order to operate the activated sludge process in a wastewater treatment plant.

Microorganisms are used to treat wastewater. Microorganisms in the treatment plant's activated sludge process treats or cleans the wastewater by using the contamination in the wastewater as their food source. The information the plant operator needs to understand are:

- How much contamination (in pounds) exists in the wastewater that needs treatment? Contamination is measured as pounds of Biochemical Oxygen Demand (BOD).
- How many microorganisms (in pounds) must be in the treatment process in order to oxidize, biodegrade or consume the contaminants the wastewater?
- How many pounds of oxygen (usually supplied as dry air) must be applied and maintained in the activated sludge process so that microbial degradation of the contamination can take place and to support microbial metabolic functions.

Like humans, animals and other organisms, the microorganisms used to treat wastewater need the right amount of food in order to survive and thrive. Organic loading in wastewater is measured as BOD which is a measure the concentration contamination or the strength of wastewater needing treatment. The BOD or organic load serves as food which the microorganisms consume and thereby remove from the wastewater. Treatment plant operator must understand and maintain the proper relationship between the contaminants (organic load) in the wastewater, the amount of microorganisms in the treatment system process, and the oxygen that must be supplied to the treatment process.

The comparison of pounds of BOD to pounds of Microorganisms is referred to as the Food to Microorganism (F/M) ratio. Most treatment plants operate at an F/M ratio of 0.2 to 0.5 lbs BOD/Day / Lbs MLVSS. This means for every 2 to 5 pounds of organic load in a volume of wastewater the treatment system must contain 10 pounds of microorganisms in order to stabilize and remove that organic load. In addition, the amount of oxygen that an operator will need to supply to an activated sludge process can vary with many factors such as water and air temperature, the BOD of the waste needing treatment, the level of treatment desired, the transfer efficiency of the oxygen delivery to microorganisms, the system microbial waste rate, etc…. However, as a general rule the operator will need to supply between 0.7 – 1.5 lbs of O_2/lb of BOD removed from the wastewater. With 1.10 Lbs of Oxygen/Lbs BOD removed being a typical value and we will use this value for this exercise.

1. **Organic Loading (Food/Microorganism Ratio)**

a. Convert a concentration of wastewater contaminants to pounds. (BOD – Microbial Food)

i. A wastewater flow rate is 6 MGD (million gallons/day) has an organic loading concentration of 250 mg/l BOD (Biochemical Oxygen Demand).

b. Determine microorganism population in pounds. (Microorganism Population)

i. A wastewater treatment tank has a volume of 3.0 (MG) million gallons and has a solids concentration of 2500 mg/l (parts per million). The solids are 81% volatile (microorganisms).

c. Comparing pounds of wastewater contamination to pounds of bacteria in the treatment system what is the Food to Microorganism Ratio? (Food/Microorganism Ratio)

(Normal Food to Microorganism Ratio is 0.2 to 0.5)

2. **Oxygen Loading Rate**

- **Given:**
  - **The normal range of oxygen demand required to stabilize BOD in the carbonaceous stage varies from 0.7 to 1.5 lb O_2/ Lb of BOD.**
  - **Air contains 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and small amounts of other gases.**
  - **1 lb of air is approximately 23.3% Oxygen or 0.233 lbs**
  - **Given 12,510 Lbs of BOD (wastewater contamination)**
- **Assume 1.1 Lbs of Oxygen (O_2) per 1 Lb of BOD removed**

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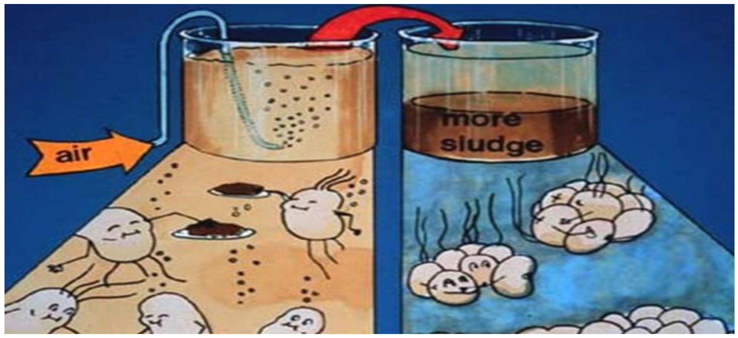
SOLUTION SHEET

Napa Tiny Bubbles Solution Sheet



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Like humans, animals and other organisms, the microorganisms used to treat wastewater need the right amount of food in order to survive and thrive. Organic loading in wastewater is measured as BOD which is a measure of the strength of wastewater needing treatment. The BOD or organic load serves as food which the microorganisms consume and thereby remove from the wastewater. Treatment plant operator must understand and maintain the proper relationship between the contaminants (organic load) in the wastewater, the amount of microorganisms in the treatment system process, and the oxygen that must be supplied to the treatment process.

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1. Organic Loading (Food/Microorganism ratio)

a. Convert a concentration of wastewater contaminants to pounds.

i. A wastewater flow rate is 6 MGD (million gallons/day) has an organic loading concentration of 250 mg/l BOD (Biochemical Oxygen Demand).

BOD (food) = 12,510 Lbs/day = 8.34 (lbs/gal x L/Mmg) x 6 MGD x 250 mg/l

b. Determine microorganism population in pounds.

i. A wastewater treatment tank has a volume of 3.0 (MG) million gallons and has a solids concentration of 2500 mg/l (parts per million). The solids are 81% volatile (microorganisms).

{Lbs/day} = 8.34(lbs/gal x L/Mmg) x Vol, [MGD] x conc, [mg/L] x % Volatile.

= 8.34 (lbs/gal x L/Mmg) * 3MG * 2500 mg/l * 81%

Lbs. of Microorganisms = 50,665.5 = 8.34 (lbs/gal x L/Mmg) * 3MG * 2500 mg/l * 0.81

c. Comparing pounds of wastewater contamination to pounds of bacteria in the treatment system what is the Food to Microorganism Ratio?

0.24 = **<u>12,510 lbs. of Wastewater Contaminants (BOD)/day</u>**

50,665 Lbs. of Treatment Microorganisms

(Normal Food to Microorganism Ratio is 0.2 to 0.5)

3. **Oxygen Loading Rate**

- **Given:**
    - **The normal range of oxygen demand required to stabilize BOD in the carbonaceous stage varies from 0.7 to 1.5 lb O_2/ Lb of BOD.**
    - **Air contains 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and small amounts of other gases.**
    - **1 lb of air is approximately 23.3% Oxygen or 0.233 lbs**
    - **Given 12,510 Lbs of BOD (wastewater contamination)**
- **Assume 1.1 Lbs of Oxygen (O_2) per 1 Lb of BOD removed**

$$\frac{1.1 \text{Lbs Oxygen}}{1.0 \text{ BOD}} = \frac{X \text{ lbs Oxygen}}{12{,}510 \text{ lbs BOD}}$$

(X) (1.0) = (1.1) (12,510) = 13,761 Lbs Oxygen

Or

$$\frac{(1.1 \text{Lbs Oxygen})(12{,}510)}{(1.0)} = X\text{Lbs Oxygen} = 13{,}761 \text{ Lbs Oxygen}$$

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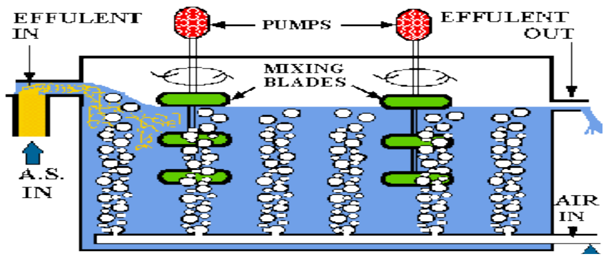
EXIT TICKET

Exit Ticket



What did you learn about organic loading and how it is calculated?

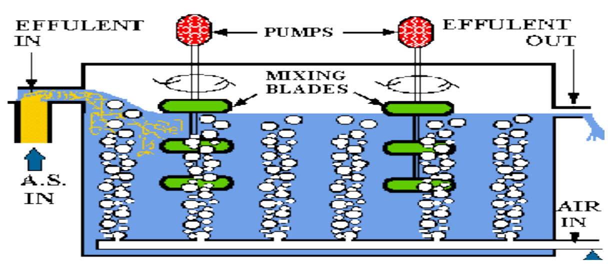
What did you learn about the ratio of food (wastewater contamination) a wastewater treatment bacteria will consume relative to its body mass?

What did you learn about how to determine the amount of oxygen an activated sludge process needs in order to stabilize or treat wastewater?

Did you find the concepts difficult to understand?

What aspect of this problem(s) was difficult to understand?

Exit Ticket



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EDUCATORS FEEDBACK FORM

Feedback Form for Teachers (Online)

Online Version of Feedback Form:
https://goo.gl/forms/esHz2B0pokGqqSWP2

Feedback Form for Teachers

I. Information on Teacher and the Module Used

Name of Teacher

Date Module was Used

Name of Class in which module was used

Number of students in class

Name of school or other organization

Name of the Contextualized Learning Module Used

II. Components of the Contextualized Learning Module Used

Yes	No	
☐	☐	A. The Problem Illustration Video
☐	☐	B. The Warm-Up Ticket
☐	☐	C. The Cover Sheet
☐	☐	D. The Solution Sheet
☐	☐	E. The Exit Tickets
☐	☐	F. Videos of individual Subject Matter Experts
☐	☐	G. Feedback form for students

III. Feedback on components of the module

A. The Problem Illustration Video

1. What did you think worked in this component of the module?
2. What did you think didn't work as well?
3. Do you have any suggestion for how we could make this component of the module more effective in future modules?

4. Not applicable—this component of the module was not used

B. The Warm-Up Ticket

1. What did you think worked in this component of the module?
2. What did you think didn't work as well?
3. Do you have any suggestion for how we could make this component of the module more effective in future modules?
4. Not applicable—this component of the module was not used

C. The Cover Sheet

1. What did you think worked in this component of the module?
2. What did you think didn't work as well?
3. Do you have any suggestion for how we could make this component of the module more effective in future modules?
4. Not applicable—this component of the module was not used

D. The Solution Sheet

1. What did you think worked in this component of the module?
2. What did you think didn't work as well?
3. Do you have any suggestion for how we could make this component of the module more effective in future modules?
4. Not applicable—this component of the module was not used

E. The Exit Tickets

1. What did you think worked in this component of the module?

2. What did you think didn't work as well?

3. Do you have any suggestion for how we could make this component of the module more effective in future modules?

4. Not applicable—this component of the module was not used

F. Videos of individual Subject Matter Experts

1. What did you think worked in this component of the module?

2. What did you think didn't work as well?

3. Do you have any suggestion for how we could make this component of the module more effective in future modules?

4. Not applicable—this component of the module was not used

G. Feedback form for students

1. What did you think worked in this component of the module?

2. What did you think didn't work as well?

3. Do you have any suggestion for how we could make this component of the module more effective in future modules?

4. Not applicable—this component of the module was not used

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STUDENTS FEEDBACK FORM

Feedback Form for Students (Online)

Go here for the Online Version of Feedback Form:
https://goo.gl/forms/3vSjzMuzFDuxY1y73

Feedback Form for Students

Please rate each of the following aspects of this lesson:

	Excellent	Very Good	Good	Fair	Poor	Very Poor
1. Video						
2. Lesson Presentation						
3. Worksheet						
4. Time Allotted						

5. What aspect or part of this lesson do you believe was the most effective at helping you reach the learning goal?

6. Where would you have wanted more training or help on this?

7. Did this curriculum increase your awareness of the water/wastewater industry?

8. Additional Comments/Suggestions:

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SCRIPT

Napa Sanitation "Tiny Bubbles" - Video Script

Cast: Steve –Operator III Lead

Stephanie – Pollution Prevention & Outreach Coordinator

Jeff - Director of Administrative Services and Chief Financial Officer (Microbe)

Elsa- Administrative Assistant (Microbe)

Rodrigo – (Goldilocks)

Introduction Scene:

Steve : Hi. My name is Steve Chavis, I'm an Operator III at the Napa Sanitation District. Our work is very important for our community and the environment. Here we operate several treatment processes to remove pollutants from the water.

Stephanie: My name is Stephanie Turnipseed and I'm the Pollution prevention and Outreach Coordinator. I have been with Napa San for about 1.5 years. In my position I give tours, conduct classroom presentations, plan events for the community, work with businesses on pollution prevention issues, issue press releases, and take care of our website and Facebook pages.

Elsa: My name is Elsa Seal. I'm an administrative assistant at Napa San and I work in the front office. I've been here for 12 years and main responsibilities are greeting visitors, answering phones, processing permits, paying invoices and offering clerical support to all departments at the District.

Jeff: My name is Jeff Tucker. I'm the Director of Administrative Services and Chief Financial Officer here at NapaSan. At NapaSan I oversee budgets, accounting, IT, safety and fleet management.

Rodrigo: Hello my name is Rodrigo Montanez. I've been working for Napa Sanitation District as a Laboratory Analyst for the past 12 years. Some of my responsibilities here in the District are to perform a wide variety of chemical, physical and bacteriological analyses. I also do data interpretation of surface, ground, wastewater and recycled water to assist in making changes to plant operations. In addition, my responsibilities include conducting field sampling and field investigations.

Stephanie: We are definitely not professional actors, and that will likely be clear after you watch this video. But, what we want you to take away from this video is not our Oscar-worthy performances, but the amount of math that goes into every process at a wastewater treatment plant. Math is needed for every operation here at Napa San. So, you could say that math helps us to protect public health, the environment, and the Napa River, which is what we all enjoy most about working here. We hope you enjoy this video as much as we enjoyed making it.

Scene 1 (This can be used as a lead-in video for a few scenarios)

Open with video of flow pouring into the aeration basin (volume turned up to capture sound. 5-10 seconds). **Picture 1 -**Aeration Tanks

Switch to shot of protozoa under the microscope actively swimming and working around a floc. (Volume quiet 5 – 10 seconds) **Picture 2 –** Laboratory, activity under microscope can be shown on monitor. If possible identify a stalked ciliate feeding.

Switch to close-up shot of aeration tank bubbles (volume turned up catching sound of the simmer , 5-10 seconds) **Picture 3-** Aeration Tanks

Switch to a different shot of protozoa under microscope active, darting (volume quiet, 5-10 seconds) **Picture 4-** Laboratory, activity under microscope can be shown on monitor.

Switch to shot of secondary clarifier weir and treated water flowing (volume turned up capturing the sound of water cascading) **Picture 5-** Secondary clarifier weir

Words "Tiny Bubbles" fades in.

Scene 2 Aeration Basin Deck (Air Requirement) **Picture 6 –** Aeration Tank/digester backdrop **: Steve talking to Stephanie**

Steve: So this is called secondary treatment. The wastewater has already gone through primary treatment where we removed debris from the wastewater such as rags, paper, diapers, wipes, sand and also heavier stuff like sludge. This water now has dissolved material in it we have to get out. We get the dissolved material out in this process called Activated Sludge.

Stephanie: Activated Sludge is the point in the treatment process where we get the microorganisms or microbes active. We get them activated to help clean the water.

Steve: Yes we use the Activated Sludge process where we grow microorganisms to eat the pollutants as a food source. Just like people, the microbes stay alive because we keep them happy. They need to be wet and fed and they need oxygen to breathe.

Scene 3 Switch to shot of the aeration tank surface (same as scene 1).

Stephanie: Look at all those tiny bubbles! Hmm, they must be heavy eaters.

Scene 4 : Three microbe actors standing in front of a bubble backdrop. Microbes slowly wake up….

Elsa: What is this place?

Stephanie: It's so warm….and bubbly!

Jeff: (*Looking into BOD box*) And look at all this food!

Everyone eats like crazy, stops for breath, repeat.

Scene 5: Same as scene 2

Steve: Aeration is one of the largest energy consumers in a treatment plant. Too much air is wasteful. Too little air causes process upsets.

Stephanie: So the microbes like just enough air. Sounds like the story of Goldilocks.

Scene 6: Scene Screenshot of Goldilocks character;

Rodrigo: Ohh that's too much, hmmph that's too little, mmm that's juuust right.

Scene 7: In Classroom (Operations Meeting Room) Backdrop: Whiteboard

Stephanie and Steve: I guess so.

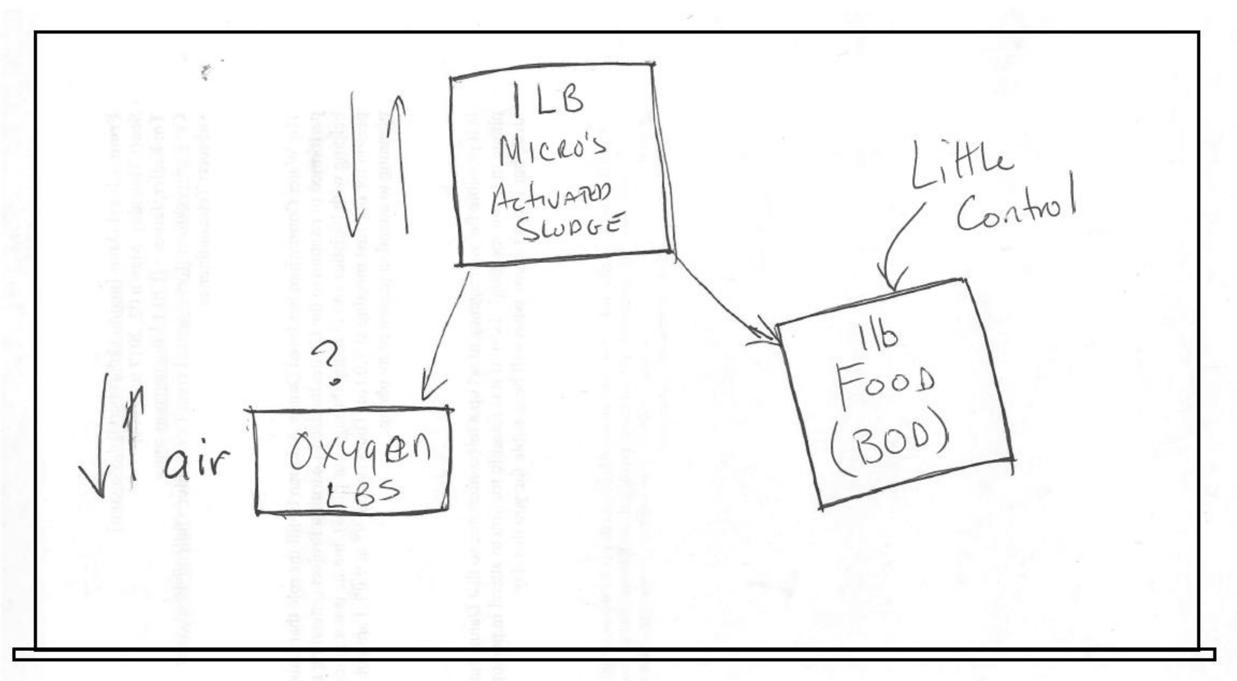
Stephanie: So how do you know how much air you need for the microbiology when you're feeding them?

Steve: This is actually a very important calculation we use both for process control and energy efficiency. Here let me illustrate this. (Steve begins to point out on the white board) we know how may pounds microorganisms we have in the system and we know how much food or BOD they can eat based on the Food to Microorganism ratio. We have little control over the quantity of food that comes in but we can control the number of organisms and the amount of air we add.

Stephanie: Okay, I'm following this, so if we know how much food is being added and we know how much oxygen is used by the microorganisms we should be able to use math to figure out how much air is needed.

Steve: Yes. Let's go do math.

Scene 7: Whiteboard Backdrop



Math problem discussion:

This builds upon the calculation of pounds of BOD previously calculated in “The Great Shake”.

1. Calculate BOD Percent Removal – Given BOD in (mg/L)

BOD out (mg/L)

Percent BOD Removal (BOD in (mg/L) – BOD out (mg/L))/ BOD in (mg/L)

2. Calculate the BOD pounds to be removed- Given Flow (MGD)

Find BOD in (lbs) = MGD x mg/L x 8.34 lbs/gal

Find BOD to remove (lbs) = BOD in (lbs) x (answer to 1. Above)

3. Calculate the oxygen requirement – Given 1.5 lbs Oxygen /lb BOD

Find Oxygen lbs/day = BOD removed x 1.5 lbs Oxygen/lb BOD

This could end here or go further as outlined below

4. Calculate lbs of air – given oxygen is 20% of air. This relates to the work in “The Air and Why We Should Care”

Find air requirement lbs/day= Oxygen lbs / 0.2

5. Calculate the adjusted air requirement for the OTE (Oxygen Transfer Efficiency) of the diffuser system- Given OTE = 22%

Find : adjusted air requirement (lbs/day) = $\frac{\text{Air Requirement (lbs/day)}}{\text{(OTE/100)}}$

6. Calculate the volume of air required – The conversion can be given to the student or the student can look up the conversion given the air temperature and the relative humidity. Say 80 degrees and 50%.

Find air volume = Air (lbs/day) / 0.0731 lbs/ft^3

Convert cubic feet per day to cubic feet per minute

Air CFM = Air CFD/ 1440 min/day

TABLE 1. DENSITY AND MOISTURE WEIGHT PER CUBIC FOOT OF AIR AND RELATIVE HUMIDITY														
	100%		90%		80%		70%		60%		50%		5%	
Temp. (°F)	Density (lb/ft³)	Moisture (lb/ft³)	Density (lb/ft³)	Moisture (lb/ft³)	Density (lb/ft³)	Moisture (lb/ft³)	Density (lb/ft³)	Moisture (lb/ft³)	Density (lb/ft³)	Moisture (lb/ft³)	Density (lb/ft³)	Moisture (lb/ft³)	Density (lb/ft³)	Moisture (lb/ft³)
32	0.0806	0.00030	0.0806	0.00027	0.0806	0.00024	0.0807	0.00021	0.0807	0.00018	0.0807	0.00015	0.0808	0.00002
36	0.0799	0.00035	0.0799	0.00032	0.0800	0.00028	0.0800	0.00025	0.0800	0.00021	0.0800	0.00018	0.0801	0.00002
40	0.0793	0.00035	0.0793	0.00037	0.0793	0.00033	0.0793	0.00029	0.0794	0.00025	0.0794	0.00021	0.0795	0.00002
60	0.0759	0.00083	0.0760	0.00075	0.0760	0.00067	0.0761	0.00058	0.0767	0.00050	0.0762	0.00042	0.0764	0.00004
70	0.0743	0.00116	0.0744	0.00104	0.0744	0.00093	0.0745	0.00081	0.0746	0.00069	0.0746	0.00058	0.0750	0.00006
72	0.0740	0.00123	0.0740	0.00111	0.0741	0.00099	0.0742	0.00086	0.0743	0.00074	0.0743	0.00062	0.0747	0.00006
76	0.0733	0.00140	0.0734	0.00126	0.0735	0.00112	0.0736	0.00098	0.0737	0.00084	0.0737	0.00070	0.0741	0.00007
80	0.0727	0.00159	0.0727	0.00143	0.0728	0.00127	0.0729	0.00111	0.0730	0.00095	0.0731	0.00079	0.0736	0.00008
84	0.0720	0.00179	0.0721	0.00161	0.0722	0.00144	0.0723	0.00126	0.0724	0.00108	0.0725	0.00090	0.0730	0.00009
88	0.0713	0.00202	0.0714	0.00182	0.0716	0.00162	0.0717	0.00142	0.0718	0.00121	0.0719	0.00101	0.0725	0.00010
92	0.0706	0.00228	0.0708	0.00205	0.0709	0.00182	0.0710	0.00159	0.0712	0.00137	0.0713	0.00114	0.0719	0.00011
96	0.0699	0.00256	0.0701	0.00230	0.0703	0.00205	0.0704	0.00179	0.0706	0.00154	0.0707	0.00128	0.0714	0.00013
100	0.0693	0.00287	0.0694	0.00258	0.0696	0.00230	0.0698	0.00201	0.0699	0.00172	0.0701	0.00143	0.0709	0.00014
110	0.0675	0.00379	0.0677	0.00341	0.0679	0.00303	0.0681	0.00265	0.0684	0.00227	0.0686	0.00189	0.0696	0.00019
120	0.0656	0.0494	0.0659	0.00445	0.0662	0.00396	0.0665	0.00346	0.0667	0.00297	0.0670	0.00247	0.0684	0.00025
130	0.0635	0.00639	0.0639	0.00575	0.0643	0.00511	0.0647	0.00447	0.0651	0.00383	0.0655	0.00319	0.0672	0.00032
140	0.0614	0.00817	0.0618	0.00735	0.0623	0.00653	0.0628	0.00572	0.0633	0.00490	0.0638	0.00408	0.0660	0.00041
150	0.0590	0.01034	0.0596	0.00931	0.0602	0.00828	0.0608	0.00724	0.0614	0.00621	0.0621	0.00517	0.0649	0.00052
160	0.0564	0.01299	0.0571	0.01169	0.0579	0.01039	0.0587	0.00909	0.0595	0.00779	0.0602	0.00649	0.0637	0.00065
170	0.0535	0.01617	0.0544	0.01455	0.0554	0.01293	0.0564	0.01132	0.0573	0.00970	0.0583	0.00808	0.0626	0.00081
180	0.0503	0.01997	0.0514	0.01797	0.0526	0.01597	0.0538	0.01398	0.0550	0.01198	0.0562	0.00998	0.0615	0.00100
190	0.0447	0.02247	0.0463	0.02022	0.0480	0.01798	0.0496	0.01573	0.0513	0.01348	0.0529	0.01124	0.0603	0.00112
200	0.0427	0.02978	0.0444	0.02680	0.0462	0.02382	0.0480	0.02084	0.0497	0.01787	0.0515	0.01489	0.0594	0.00149

1

4

baywork

bay area water/wastewater workforce reliability

STORYBOARD

FILMING STORYBOARD

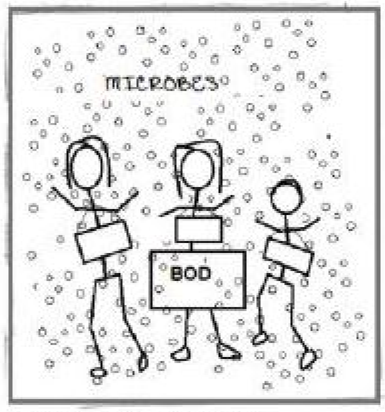
1 - NAPA SAN BOARD ROOM

INTRODUCTION SCENE

JEFF/ STEVE/ ELSA/ RODRIGO/ STEPHANIE

2 - OPERATONS MEETING ROOM

SCENE 4



JEFF/ ELSA/ STEPHANIE

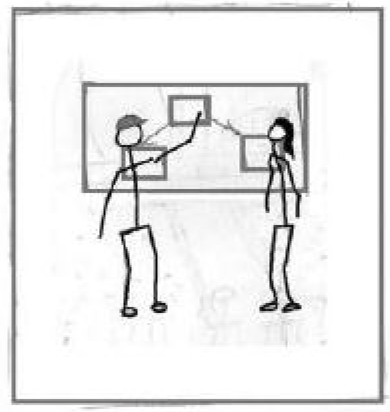
3 - OPERATONS MEETING ROOM

SCENE 6

RODRIGO

4 - OPERATONS MEETING ROOM

SCENE 7



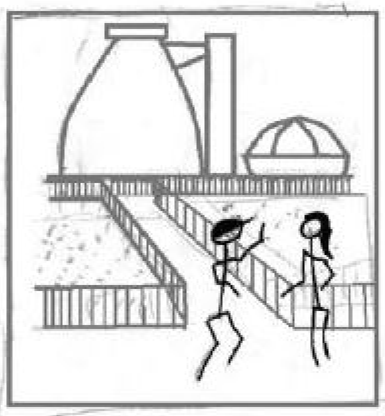
STEVE & STEPHANIE

5 - LABORATORY

SCENE 1 - ACTIVE MICROBIOLOGY VIDEO SHOTS

6 - AERATION BASIN DECK

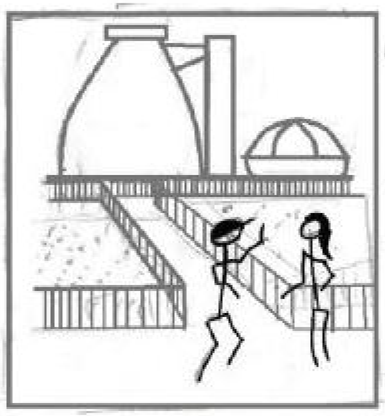
SCENE 2



STEVE & STEPHANIE

7- AERATION BASIN DECK

SCENE 5

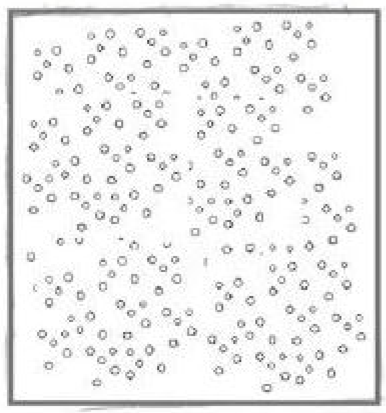


STEVE & STEPHANIE

8 - SHOT OF AERATION SURFACE

SCENE 1 SHOT OF AERATION SURFACE WITH PRONOUNCED SIMMERING SOUND OF THE AIR BUBBLES

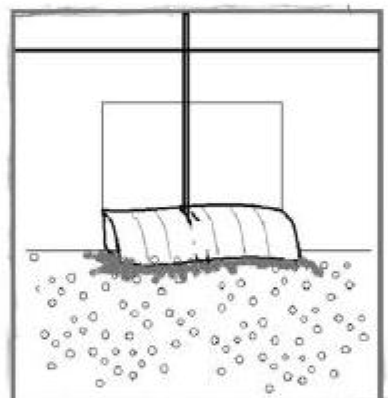
SCENE 3 WITH VOICE OVER OF STEPHANIE



STEPHANIE VOICE OVER

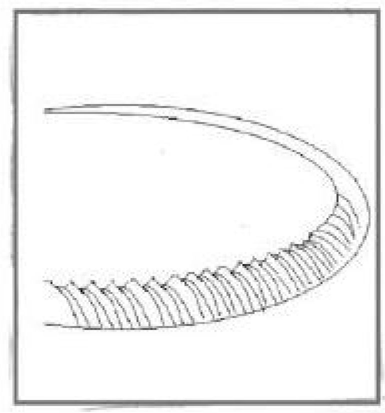
9 - AERATION TANK INFLUENT

SCENE 1- TANK INFLUENT WITH PRONOUNCED SOUND OF CASCADING WATER.



10 - FINAL CLARIFIER EFFLUENT

SCENE 1 - CLEAN TREATED WATER FLOWING OVER THE SECONDARY CLARIFIER WEIR WITH PRONOUNCED SOUND OF CASCADING WATER



baywork

bay area water/wastewater
workforce reliability

CUE CARDS

Steve : **1A**

Hi. My name is Steve Chavis,

I’m an Operator III at the Napa Sanitation District.

Our work is very important for our community and the environment.

Steve (con’t): **1B**

Here we operate several treatment processes to remove pollutants from the water.

Stephanie: **2A**

My name is Stephanie Turnipseed and I'm the Pollution prevention and Outreach Coordinator. I have been with Napa San for about 1.5 years. In my position I give tours, conduct classroom presentations, plan events

Stephanie(con't): **2B**

for the community, work with businesses on pollution prevention issues, issue press releases, and take care of our website and Facebook pages.

Elsa: **3A**

My name is Elsa Seal. I’m an administrative assistant at Napa San and I work in the front office. I’ve been here for 12 years and main responsibilities are greeting visitors, answering phones, processing

Elsa (Con’t): 3B

permits, paying invoices and offering clerical support to all departments at the District.

Jeff: **4**

My name is Jeff Tucker. I'm the Director of Administrative Services and Chief Financial Officer here at NapaSan. At NapaSan I oversee budgets, accounting, IT, safety and fleet management.

Rodrigo: **5A**

Hello my name is Rodrigo Montanez. I've been working for Napa Sanitation District as a Laboratory Analyst for the past 12 years. Some of my responsibilities here in the District are to perform a wide variety of chemical, physical and bacteriological analyses. I also do data interpretation of

Rodrigo (Con't): 5B

surface, ground, wastewater and recycled water to assist in making changes to plant operations. In addition, my responsibilities include conducting field sampling and field investigations.

Stephanie: **6A**

We are definitely not professional actors, and that will likely be clear after you watch this video. But, what we want you to take away from this video is not our Oscar-worthy performances, but the amount of

Stephanie (Con't): 6B

math that goes into every process at a wastewater treatment plant. Math is needed for every operation here at Napa San. So, you could say that math helps us to protect public health, the environment, and the

Stephanie (Con’t): 6C

Napa River, which is what we all enjoy most about working here. We hope you enjoy this video as much as we enjoyed making it.

Scene 2 Aeration Basin Deck (Air Requirement) **Picture 6 –** Aeration Tank/digester backdrop **: Steve talking to Stephanie**

Steve: **7**

So this is called secondary treatment. The wastewater has already gone through primary treatment where we removed debris from the wastewater such as rags, paper , diapers, wipes,

Steve (con't): 8

sand and also heavier stuff like sludge. This water now has dissolved material in it we have to get out. We get the dissolved material out in this process called Activated Sludge.

Stephanie: **9**

Activated Sludge is the point in the treatment process where we get the microorganisms, or microbes active. We get them activated to help clean the water.

Steve: **10**

Yes we use the Activated Sludge process where we grow microorganisms to eat the pollutants as a food source.

Steve (con't) **11**

Just like people, the microbes stay alive because we keep them happy . They need to be wet and fed and they need oxygen to breathe.

Scene 3 Switch to shot of the aeration tank surface (same as scene 1).

Stephanie: (Voice only) **12**

Look at all those tiny bubbles!

Hmm, they must be heavy eaters.

Scene 4 : Three microbe actors standing in front of a bubble backdrop. Microbes slowly wake up….

Elsa: What is this place?

Steph: It's so warm….and bubbly!

Jeff: (*Looking into BOD box*) And look at all this food!

Everyone eats like crazy, stops for breath, repeat.

Scene 5: Same as scene 2

Steve: **14**

Aeration is one of the largest energy consumers in a treatment plant.

Too much air is wasteful.

Too little air causes process upsets.

Stephanie: **15**

So the microbes like just enough air.

Sounds like the story of Goldilocks.

Scene 6: Scene Screenshot of Goldilocks character;

Goldilocks: **16**

Ohh that’s too much,

hmmph that’s too little,

mmm that’s juuust right.

Scene 7: In Meeting Room at White Board

Stephanie and Steve: **17**

I guess so.

Stephanie: **18**

So how do you know how much air you need for the microbiology when you're feeding them?

Steve: **19**

This is actually a very important calculation we use both for process control and energy efficiency. Here let me illustrate this. (*Steve begins to point out on the white board*) We know how many pounds of

Steve (con't): 20

microorganisms we have in the system and we know how much food or BOD they can eat based on the Food to Microorganism ratio.

Steve (con't): **21**

We have little control over the amount of food that comes in but we can control the number of organisms and the amount of air we add.

Stephanie: **22**

Okay, I’m following this, so if we know how much food is being added and we know how much oxygen is used by the microorganisms

Stephanie (Con’t): **23**

we should be able to use math to figure out how much air is needed.

Steve: **24**

Yes. Let’s go do math.