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WATER CAREER PATHWAYS
Your Future is Clear.

Career Pathways Summit 2016: *Building Partnerships between Industry & Education*

Welcome

Mike Wallis,
Director of Operations and Maintenance, East Bay Municipal Utility District

Candidate Development

Ingrid Bella, BAYWORK Chair


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A REGIONAL PARTNERSHIP

Our Signatory Agencies

and

WATER CAREER PATHWAYS

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Mission-Critical Job Categories

- Electrician
- Electronic Maintenance Technician/Instrument Technician
- Engineer
- Machinist/Mechanic
- Wastewater Treatment Operator
- Water Distribution Operator
- Water Treatment Operator
- Wastewater Collections Operator

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Workforce Reliability Roadmap

- Develop qualified candidates for mission-critical jobs
- Provide staff with the information needed to do quality work
- Modify work to optimize use of staff available
- Maximize cost-effectiveness of investments through collaboration

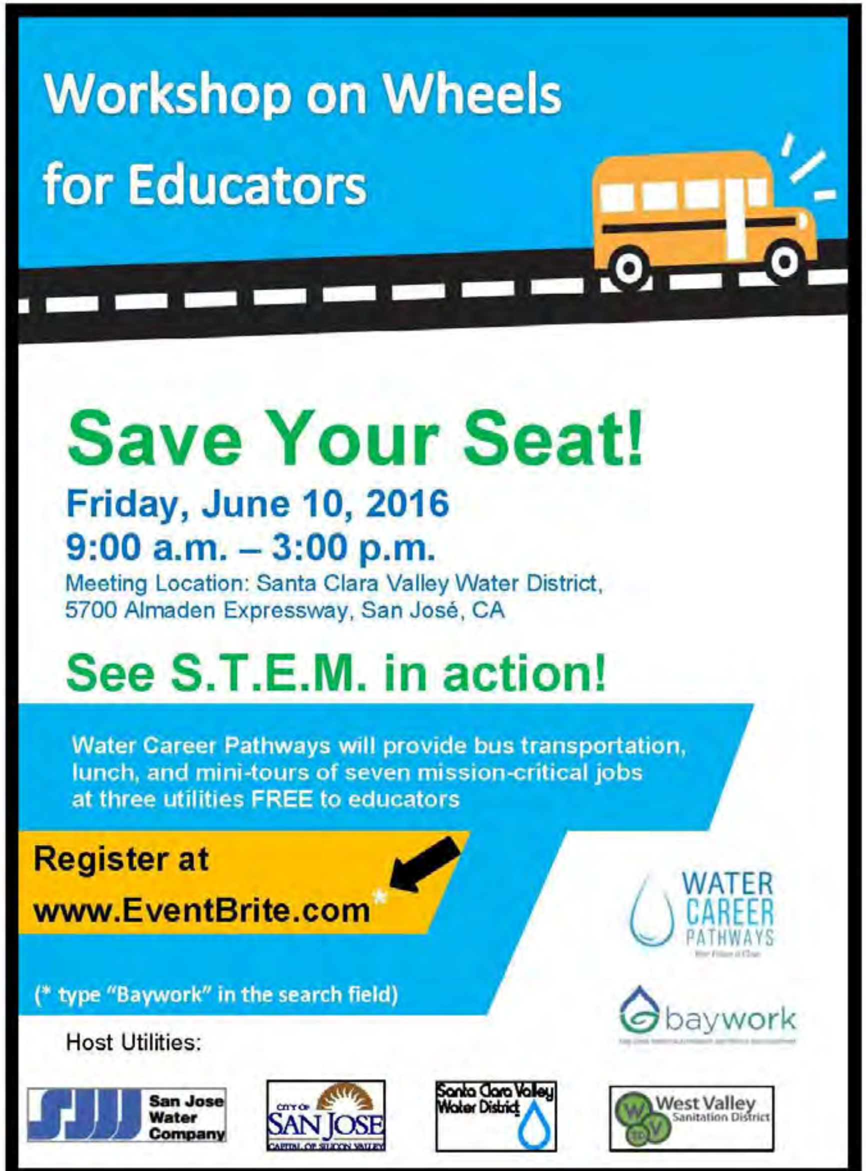
Collaboration with Education

- Career Fairs
- Classroom Presentations
- Facility tours for students
- Internship Guidebook

New Projects FY 2015-16

- **Contextualized Learning Projects**
- **Workshop on Wheels for Educators**

Collaboration with Education



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Summit 2016 Feedback Form

FEEDBACK FORM
Water/Wastewater Career Pathways Summit
May 12, 2016

Please take a few minutes to provide us with some important feedback about your experience today. This information will be used to improve future workshops. Please fill out information related to any parts of the program you attended.

I. Contextualized Learning Workshop

a) Which best describes your overall experience?

___ I liked it a lot   ___ It was OK   ___ I didn't like it

b) Please tell us what you liked.

c) How useful was the information presented?

Presentation:	___ Very useful	___ Useful	___ Not useful
Handouts:	___ Very useful	___ Useful	___ Not useful
Panel Discussion:	___ Very useful	___ Useful	___ Not useful

d) Please tell us what we could improve upon. What would you like to see more of? What could be streamlined?

e) Do you have suggestions for topics you would like to see covered at future BAYWORK workshops to support increased production, distribution, and utilization of contextualized learning materials?

f) Do you have suggestions for how BAYWORK should distribute and encourage utilization of contextualized learning materials?

g) Any other feedback?

Internship Guide Workshop

Steve Currie, BAYWORK Candidate Development Co-Chair

Internship Workshop

- The Internship Guidebook: A Free Resource to Industry
- Building Better Internships through Collaboration
- Internships: What’s Next?

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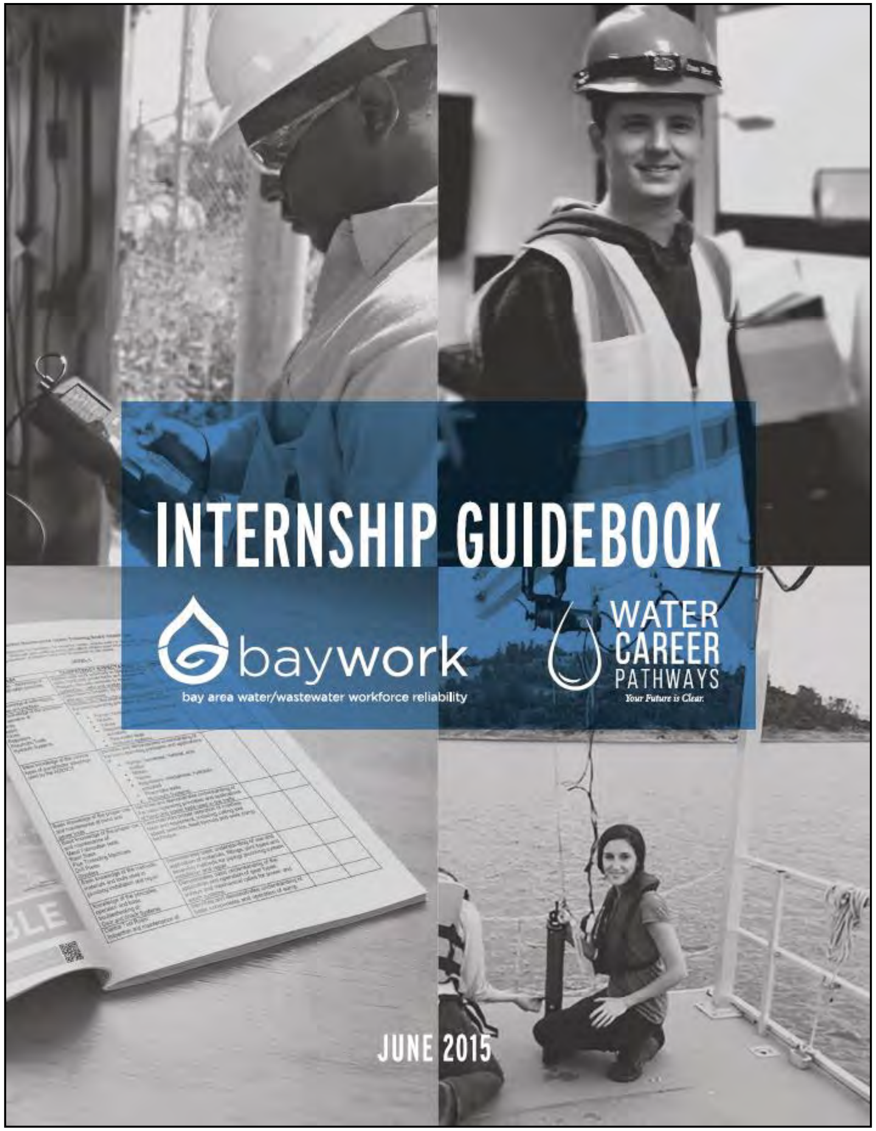
Internship Guidebook



Contextualized Learning Workshop

Renée Willette, BAYWORK
Candidate Development Co-Chair

Contextualized Learning Workshop

- The Process
- The Products
- Contextualized Learning: What's next?

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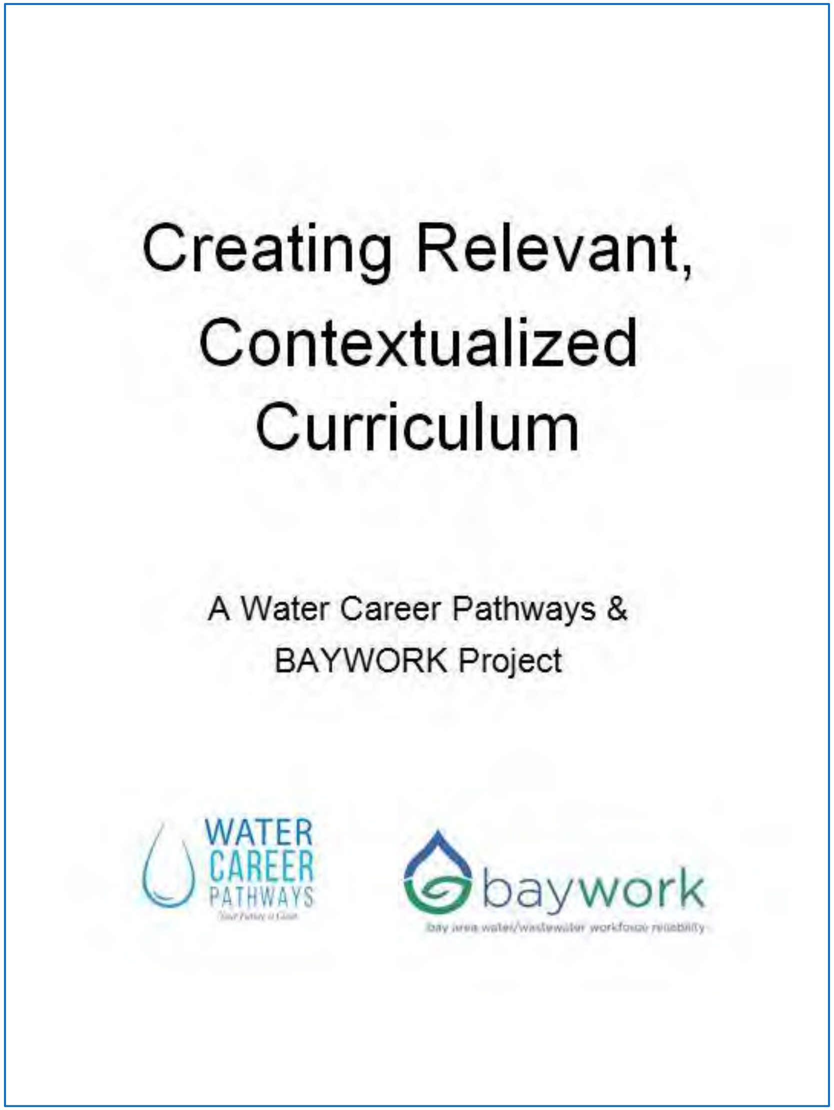
Contextualized Learning Workshop



Creating Relevant, Contextualized Curriculum

A Water Career Pathways & BAYWORK Project

Contextualized Learning Workshop

"The Perfect Storm" EBMUD Pilot Project

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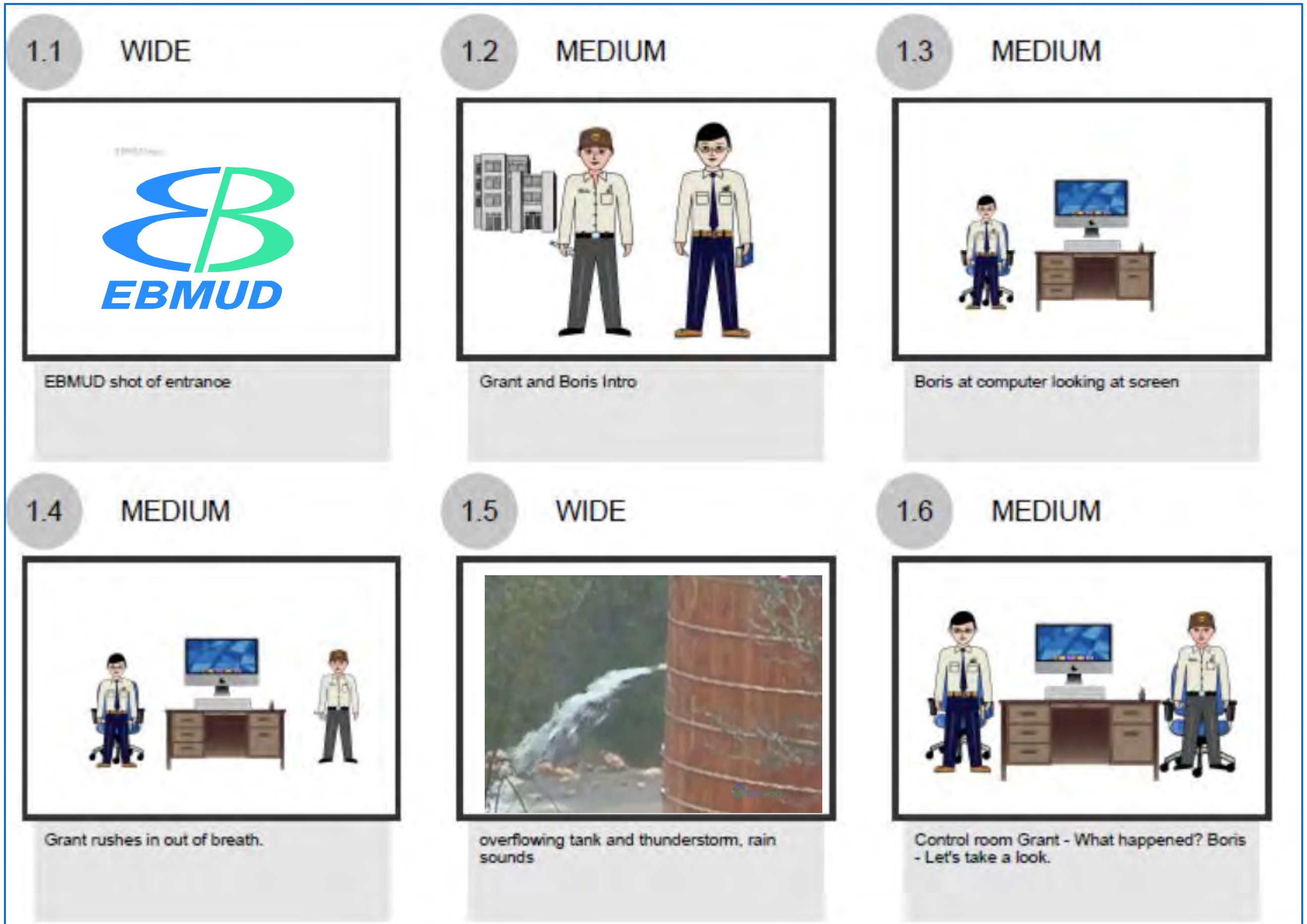
"The Perfect Storm" EBMUD Pilot Project

Subject Matter Expert –
Grant Gilley, EBMUD

- Who I am
- Why I wanted to participate
- Products

"The Perfect Storm" EBMUD Pilot Project

Storyboard



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"The Perfect Storm" EBMUD Pilot Project

Script

INTRODUCTION

GRANT GILLEY

BORIS NOSS

Grant and Boris standing outside EBMUD plant

GRANT GILLEY

Hi. My name is Grant Gilley.

BORIS NOSS

And my name is Boris Noss. We are instrument technicians at East Bay Municipal Utility District.

GRANT GILLEY

Our math skills are necessary in order for our agency to provide reliable water and wastewater service to over a million people in Northern California.

BORIS NOSS

We know that students sometimes wonder where they will need to use math skills - we know we did when we were in school. We thought it might interest you to see an example of why math matters. The following is a mock event.

SCENE 1 - CONTROL ROOM

Boris is sitting at a chair with his coffee, looking at the monitors.

GRANT GILLEY

"Boris, There's a problem! The water tank is overflowing!!"

BORIS NOSS

"What? The water levels are fine"

cut to computer screen showing all is fine

GRANT GILLEY

"Dude, get out of that chair and look outside!"

cut to overflowing tank and thunderstorm

(CONTINUED)

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"The Perfect Storm" EBMUD Pilot Project

Location Scouting

“The Perfect Storm” EBMUD Pilot Project

Video

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Candidate Development Videos


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MISSION-CRITICAL PROFILE QUESTIONNAIRE

Name: Grant Gilley

Organization: EBMUD

E-mail: ggilley@ebmud.com

Work Phone: 5109101261

Job Category (Check one below):

- ☐ Water Treatment
- ☐ Water Distribution
- ☐ Wastewater Treatment
- ☐ Wastewater Collections
- ☒ Electronic Maintenance Technician/ Instrument Technician
- ☐ Electrician/Electrical Line Worker
- ☐ Machinist/Mechanic
- ☐ Other

1. Please describe the work you do:

Install, repair, and maintain instrumentation which monitors and controls industrial processes. I commonly check to see if sensors in the field are reporting accurately, troubleshoot equipment or communication faults, or perform routine testing to find malfunctioning field devices, before they present a problem.

2. What combination of education, vocational training, apprenticeship, experience, and/or skill did you obtain in order to be qualified and selected for your job?

I worked with tools such as wrenches, ratchets, taps, dies, drills, impact tools, and other hand tools, since I was young (my family owns a farm equipment manufacturing plant in Fresno). At age 23, joined Navy as Electricians mate and developed electrical controls troubleshooting skills. AT age 27 left Navy and hired on at 700MW old power plant. Quickly improved instrumentation and electrical skills, under instruction of senior technicians (having an average of 20 year experience each). Since I previously had limited electronics and computer controls training, took classes at LMC to increase skills. At age 31 hired on with EBMUD.

3. What do you like best about your job?

The versatility of this work is nice: We do work that engages us physically and mentally. Room for growth (challenging work): As we are often working with aging infrastructure, we are wrought with controls that can be improved. Great cost savings and reliability improvements can be created and implemented at my level. I feel like I have the ability to make a difference. I also feel like my job is important. If large groups of people stop having drinking/cooking/bathing water, or all their toilets back up, the true importance of what we do can be seen (fortunately this doesn't happen, partly because of the work that my group performs).


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MISSION-CRITICAL PROFILE QUESTIONNAIRE

Name: BORIS NOSS

Organization: EAST BAY MUNICIPAL UTILITY DISTRICT, WASTEWATER TREATMENT DIVISION

E-mail: bnoss@ebmud.com

Job Category (Check one below):

- ☐ Water Treatment
- ☐ Water Distribution
- ☐ Wastewater Treatment
- ☐ Wastewater Distribution
- ☐ Other
- X Electronic Maintenance Technician/ Instrument Technician
- ☐ Electrician/Electrical Line Worker
- ☐ Machinist/Mechanic
- ☐ Wastewater Collections Operator

2. What combination of education, vocational training, apprenticeship, experience, and/or skill did you obtain in order to be qualified and selected for your job?

I gained most of my expertise learning on the job. Some employers have had formal training systems in place for me as a new hire instrumentation and control technician. Since control systems have a component of vendor-specific training, some of these employers have often sent me to various vendor training courses.

My formal education includes an A.S. in Electrical Technology from Los Medanos College. Prior to entering this field I had an FAA Airframe and Powerplant Mechanic's license as well as a B.A. in English. I've used each of these earlier experiences to make myself a stronger technician today.

Through my experience in this particular field, I've also attained an International Association of Automation certification as a Certified Control Systems Technician, level 2. In the future, I hope to obtain an ISA certification as a Certified Automation Professional.

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"The Perfect Storm" EBMUD Pilot Project

Instructional Designer - Tue Rust, Los Medanos College

- Who I am
- Why I wanted to participate
- Products

Curriculum Deliverables

Warm-up & exit ticket

Warm-Up:

1. Find the equation of the line between the points $(1.2, -3.5)$ and $(-8.4, 7.9)$.

2. You buy a bottle of water that says it should have 16.9 ounces in it, but it actually has 16.5 ounces in it. What is the percent error between those amounts? What does that number mean in this context?

Exit Ticket:

1. In your own words, describe what you learned today?

2. How difficult did you find this problem?

3. What part of the problem was the most difficult for you?

Curriculum Deliverables

Coversheet for teachers

The Perfect Storm

Introduction: The following lesson introduces students to linear functions in the context of water pressure vs. water tank's height.

Materials:

- Projector connected to a computer with internet to play videos for the lesson
- Copies of each of the following:
  - Warm-Up and Exit Ticket
  - The Perfect Storm Worksheet
  - Water Treatment Conversion Sheet Entitled "State of California, Department of Public Health: Drinking Water Operator Certification Program"
  - Student Surveys

Estimated Timeframe:

- 45 minutes to an 1 hour, depending on how you spread and imbed your think time

Prior Knowledge/Skills Needed:

Before this application lesson, students must be able to:

- Find the equation of a line given 2 points
- Find percent of a number

Common Core State Standards:

CCSS.MATH.HS.A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

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

Additional Common Core State Standards:

CCSS.MATH.HS.N-Q.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; choose and interpret the scale and the origin in graphs and data displays.

CCSS.MATH.HS.N-Q.2: Define appropriate quantities for the purpose of descriptive modeling.

CCSS.MATH.HS.A-SSE.1: Interpret expressions that represent a quantity in terms of its context.

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.

Curriculum Deliverables

Math problem worksheet

The Perfect Storm Worksheet

The transmitter senses the water pressure (sensor's input), which is determined by the water height in the tank; the transmitter sends a representative signal (transmitter's output) to the plant's control system. The transmitter's *LINEAR* output signal represents water height in the tank, in such a way that a signal of 4 milliamps represents a water level of 0 feet, and a signal of 20 milliamps represents a level of 19.8 feet of water. We used this pressure pump to apply a precise pressure to the sensor at 5 points along its "input range" and we wrote down the output signal values for each step. We need to see if the sensor's output is within 2% tolerance, of the original input versus output signal range it was calibrated to represent.

Below are the data we gathered from the transmitter. Is this within tolerance? Use this worksheet to help us solve this problem.

Input (ft)	0	4.9	9.8	14.7	19.6
Actual Output (mA)	3.96	7.76	11.52	15.52	19.4
Expected Output(mA)					
Precent Error					

The **actual output** values are the actual values from the transmitter. We're not sure if they are accurate so we need to find the **expected output** values from a mathematical model. By comparing the expected and actual output values, we can determine if the transmitter is functioning correctly. To create a math model we need to know a little about the tank and the transmitter. The tank can have between 0 to 19.6 feet of water in it. The transmitter ranges from 4 to 20 mA. Thus if there is 0 feet of water in the tank, the transmitter should read 4mA. If there is 19.6 feet of water in the tank the transmitter should read 20mA. This will take a few steps. Are you ready?

Create a linear equation and then fill in the expected outputs.

1. Define your variables in a complete sentence and algebraically.

2. Determine the constants of the equation. For linear equations, this is the slope and the y-intercept.

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Curriculum Deliverables

Answer sheet for teachers

The Perfect Storm Worksheet – Answer Sheet

The transmitter senses the water pressure (sensor's input), which is determined by the water height in the tank; the transmitter sends a representative signal (transmitter's output) to the plant's control system. The transmitter's *LINEAR* output signal represents water height in the tank, in such a way that a signal of 4 milliamps represents a water level of 0 feet, and a signal of 20 milliamps represents a level of 19.6 feet of water. We used this pressure pump to apply a precise pressure to the sensor at 5 points along its "input range" and we wrote down the output signal values for each step. We need to see if the sensor's output is within 2% tolerance, of the original input versus output signal range it was calibrated to represent.

Below are the data we gathered from the transmitter. Is this within tolerance? Use this worksheet to help us solve this problem.

Input (ft)	0	4.9	9.8	14.7	19.6
Actual Output (mA)	3.96	7.76	11.52	15.52	19.4
Expected Output(mA)	*4*	*8*	*12*	*16*	*20*
Percent Error	*-.25%*	*-1.5%*	*-3%*	*-3%*	*-3.75%*

The **actual output** values are the actual values from the transmitter. We're not sure if they are accurate so we need to find the **expected output** values from a mathematical model. By comparing the expected and actual output values, we can determine if the transmitter is functioning correctly. To create a math model we need to know a little about the tank and the transmitter. The tank can have between 0 to 19.6 feet of water in it. The transmitter ranges from 4 to 20 mA. Thus if there is 0 feet of water in the tank, the transmitter should read 4mA. If there is 19.6 feet of water in the tank the transmitter should read 20mA. This will take a few steps. Are you ready?

Create a linear equation and then fill in the expected outputs.

1. Define your variables in a complete sentence and algebraically.

   Y or Expected Outcome: Milliamps measured by the transmitter when working accurately. The transmitter senses water pressure.

   X or Input: Water level in the tank, which is the water height in feet.

2. Determine the constants of the equation. For linear equations, this is the slope and the y-intercept.
   a: Y-intercept

   Y = a + bX;   a = Y(When x=0) − bX(x=0);   a=Y(When x=0);   a = 4

   b: the slope

   Y = a + bX;   Y(when x=19.6) = 4 + b X(X=19.6);   20 = 4 + 19.6b;   b = 16/19.6 = .816

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“The Perfect Storm” EBMUD Pilot Project

Panel Discussion

The Evolution of the Contextualized Learning Project:

A Work in Progress

Mission-Critical Job Categories

- Electrician
- Electronic Maintenance Technician/Instrument Technician
- Engineer
- Machinist/Mechanic
- Wastewater Treatment Operator
- Water Distribution Operator
- Water Treatment Operator
- Wastewater Collections Operator

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Contextualized Learning Project

All of these mission-critical jobs require vocational training

Many students graduate from high school without the skills needed to be successful in vocational training

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"Only 37% of American 12th-graders were academically prepared for college math and reading in 2015, a slight dip from two years earlier, according to tests" by the National Assessment of Educational Progress, also known as the "Nation's Report Card."

April 27, 2016 WSJ article

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Electronic Maintenance Technician/Instrument Technician: Career Pathway Data

The tables below organize Career Pathways research completed so far by the BAYWORK team. We have data in three areas:

1. Suggested coursework and experiences for high school students interested in becoming an EMT/Instrument Tech
2. Sample questions reflecting the skills needed for vocational training in EMT/Instrument Technician
3. Training opportunities in the Bay Area for careers aas an EMT/Instrument Technician

Suggested High School Coursework and Experiences

Course/Experience	Suggested High School Coursework and Experiences
ALGEBRA	X
GEOMETRY	X
TRIGONOMETRY	X
PRE-CALCULUS	X
TYPING	X
ENGLISH (READING/WRITING)	X
PHYSICS	X
CHEMISTRY	X
COMPUTER APPLICATIONS	X
TECHNICAL DRAFTING	X
ELECTRICITY/ELECTRONICS	X
INTRO TO ENTINEERING	X
AUTO SHOP	
WELDING	
METAL SHOP	X
WOODSHOP	
MAINTENANCE AND REPAIR OF BICYCLES OR MOTOR VEHICLES	X
BUILDING CONSTRUCTION AND REPAIR	X
WOOD/METAL CRAFTING	X
MACHINERY REPAIR	X
BUILDING OR MAINTAINING COMPUTERS	X
BIOLOGY	X

Training Opportunities in the Bay Area for Careers in EMT/Instrument Technician

Training Institution	Type Of Training Institution	Training Program	Link to Training Program
Gavilan College	Community College	Water And Wastewater Technology	http://www.gavilan.edu/water/

Machinist/Mechanic: Career Pathway Data

The tables below organize Career Pathways research completed so far by the BAYWORK team. We have data in two areas:

1. Suggested coursework and experiences for high school students interested in becoming a Machinist/Mechanic
2. Training opportunities in the Bay Area for careers as Machinist/Mechanic

Suggested High School Coursework and Experiences

Course/Experience	Suggested High School Coursework and Experiences
ALGEBRA	X
GEOMETRY	X
TRIGONOMETRY	X
PRE-CALCULUS	
ENGLISH (READING/WRITING)	X
PHYSICS	
CHEMISTRY	
COMPUTER APPLICATIONS	X
TECHNICAL DRAFTING	
ELECTRICITY/ELECTRONICS	X
INTRO TO ENTINEERING	X
AUTO SHOP	X
WELDING	X
METAL SHOP	X
WOODSHOP	X
MAINTENANCE AND REPAIR OF BICYCLES OR MOTOR VEHICLES	X
BUILDING CONSTRUCTION AND REPAIR	
WOOD/METAL CRAFTING	
MACHINERY REPAIR	X
BUILDING OR MAINTAINING COMPUTERS	
BIOLOGY	

Training Opportunities in the Bay Area for Careers in Mechanics

Training Institution	Type Of Training Institution	Training Program	Link to Training Program
Gavilan College	Community College	Water And Wastewater Technology	http://www.gavilan.edu/water/
Napa Valley College	Community College	Machine Tool Technology	http://www.napavalley.edu/academics/technicaldivi

Contextualized Learning Project

We want to motivate students by:

- Creating videos showing real people using math, science, and communication skills to solve real problems

- Featuring personal stories of skilled trades workers (in multiple languages)

- Providing companion curriculum developed by instructional designers

Who we are not: Hollywood

- Not used to writing scripts
- Not used to memorizing dialog
- Not trained actors

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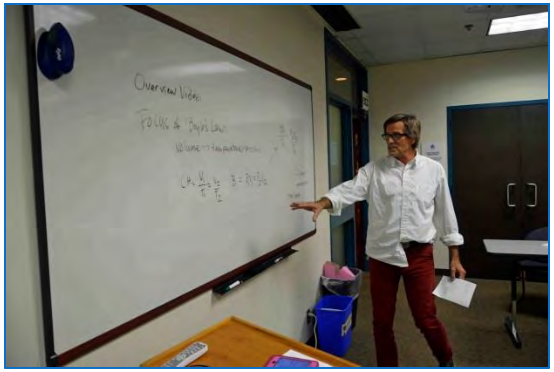
Contextualized Learning Project

Who we are:

- Water and wastewater staff who want to help educators teach students the skills they will need to be successful

Contextualized Learning Project

Brainstorming and kick-off meetings



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Contextualized Learning Project

Script – the evolution

The Perfect Storm

Contextualized Learning Script

Video One

Prelude:

Grant: Hi. My name is Grant Gilley.

Boris: And my name is Boris Noss. We are instrument technicians at East Bay Municipal Utility District.

Grant: Our math skills are necessary in order for our agency to provide reliable water and wastewater service to over a million people in Northern California.

Boris: We know that students sometimes wonder where they will need to use math skills – we know we did when we were in school. We thought it might interest you to see an example of why math matters.

Scene One– Control Room

Boris is sitting at a chair with his coffee, looking at the monitors.

Grant: "Boris, There's a problem! The water tank is overflowing!!"

Boris: "What? The water levels are fine"

Cut to computer Screen

(B-Roll of computer screen showing a graph which shows everything is fine)

Grant: "Dude, get out of that chair and look outside!"

Cut to overflowing tank

(B-Roll of overflowing tank and thunderstorm)

Boris: "Oh man why didn't you tell me sooner?"

(Grant is shaking his head)

Boris: (On the phone) "Turn the pumps off now!"

Cut to sign saying "later..."

INTRODUCTION

GRANT GILLEY

BORIS NOSS

Grant and Boris standing outside EBMUD plant

GRANT GILLEY

Hi. My name is Grant Gilley.

BORIS NOSS

And my name is Boris Noss. We are instrument technicians at East Bay Municipal Utility District.

GRANT GILLEY

Our math skills are necessary in order for our agency to provide reliable water and wastewater service to over a million people in Northern California.

BORIS NOSS

We know that students sometimes wonder where they will need to use math skills - we know we did when we were in school. We thought it might interest you to see an example of why math matters. The following is a mock event.

SCENE 1 - CONTROL ROOM

Boris is sitting at a chair with his coffee, looking at the monitors.

GRANT GILLEY

"Boris, There's a problem! The water tank is overflowing!!"

BORIS NOSS

"What? The water levels are fine"

cut to computer screen showing all is fine

GRANT GILLEY

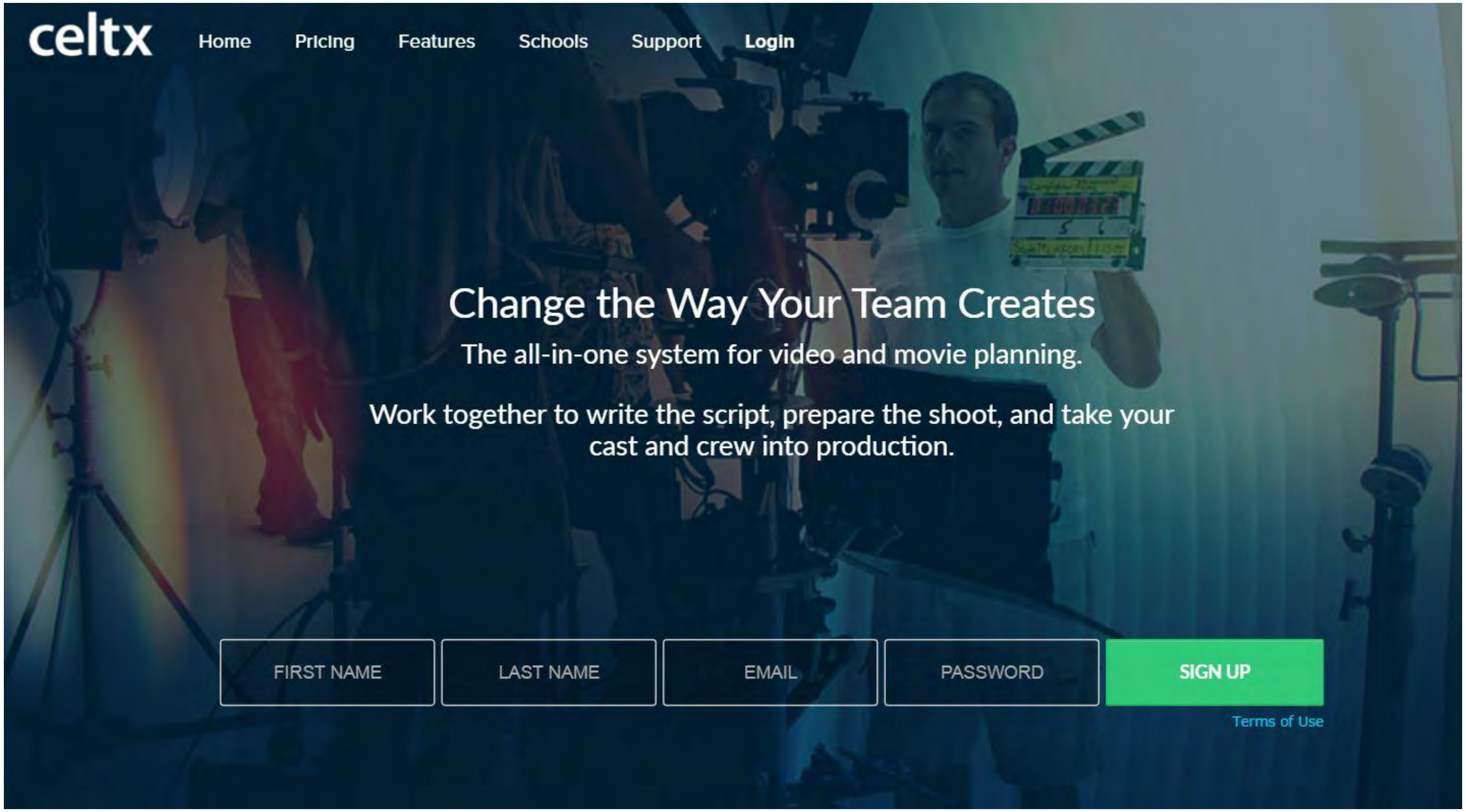
"Dude, get out of that chair and look outside!"

cut to overflowing tank and thunderstorm

(CONTINUED)

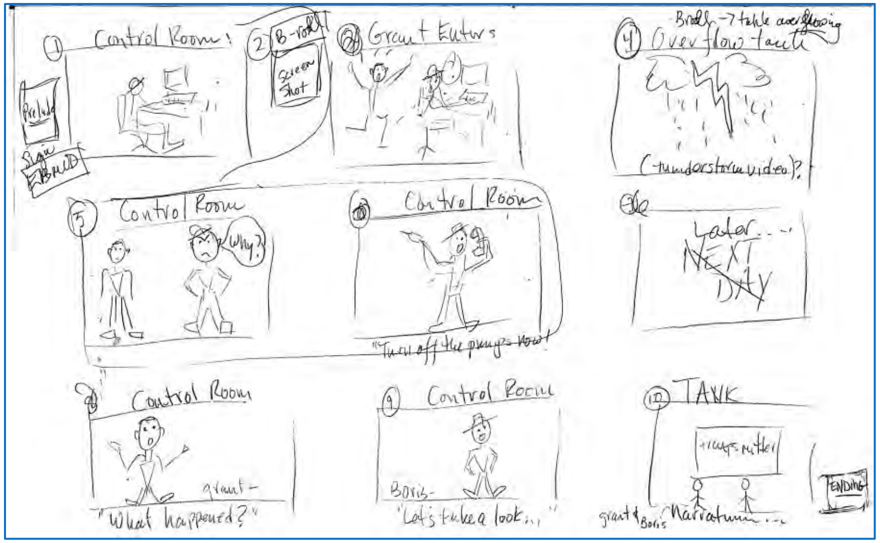
Film and video planning package

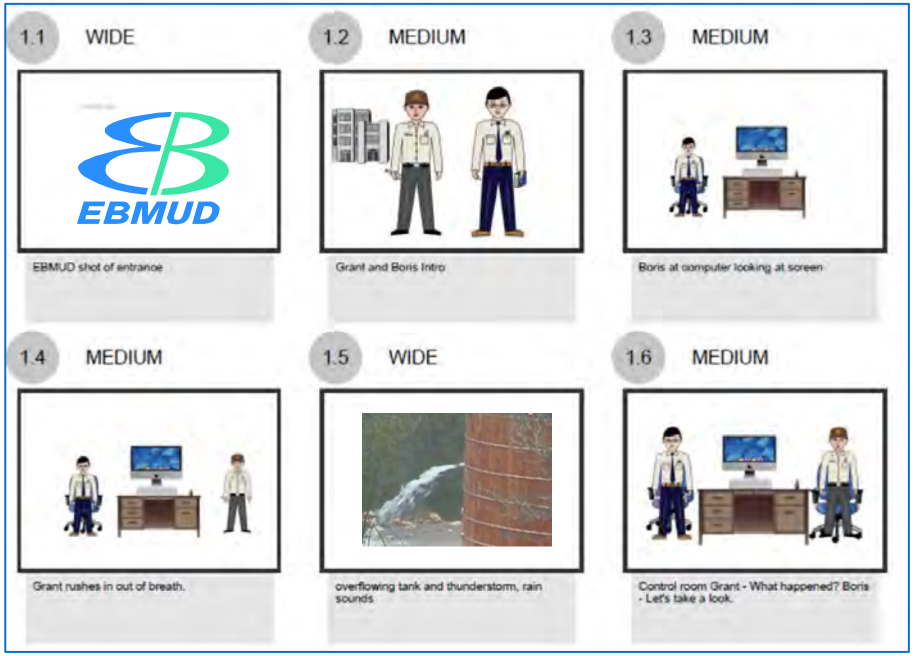
- Celtx



Contextualized Learning Project

Storyboard – the evolution





Contextualized Learning Project

Site visits for location scouting


Briones Reservoir


EBMUD Orinda Water Treatment Plant


SFPUC Southeast Wastewater Treatment Plant

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Contextualized Learning Project

Call Sheet – the evolution

Napa San Contextualized Learning Filming Schedule for "Earthquake 2014"

Thursday, Feb. 18, 2016

Start time: 9:00 a.m.

Shoot 1: Entrance to Napa San with logo in background

- INTRO with Steve, Gabe, Andrew, and panel operator
- ENDING with Steve and Gabe

Shoot 2: SCENE 1: parking lot and trucks

Shoot 3: SCENE 2: Control Room

- Gabe and Panel Operator

Shoot 4: SCENE 5: Control Room

- Gabe and Rodrigo

Shoot 5: SCENE 3: Walking to Tanks

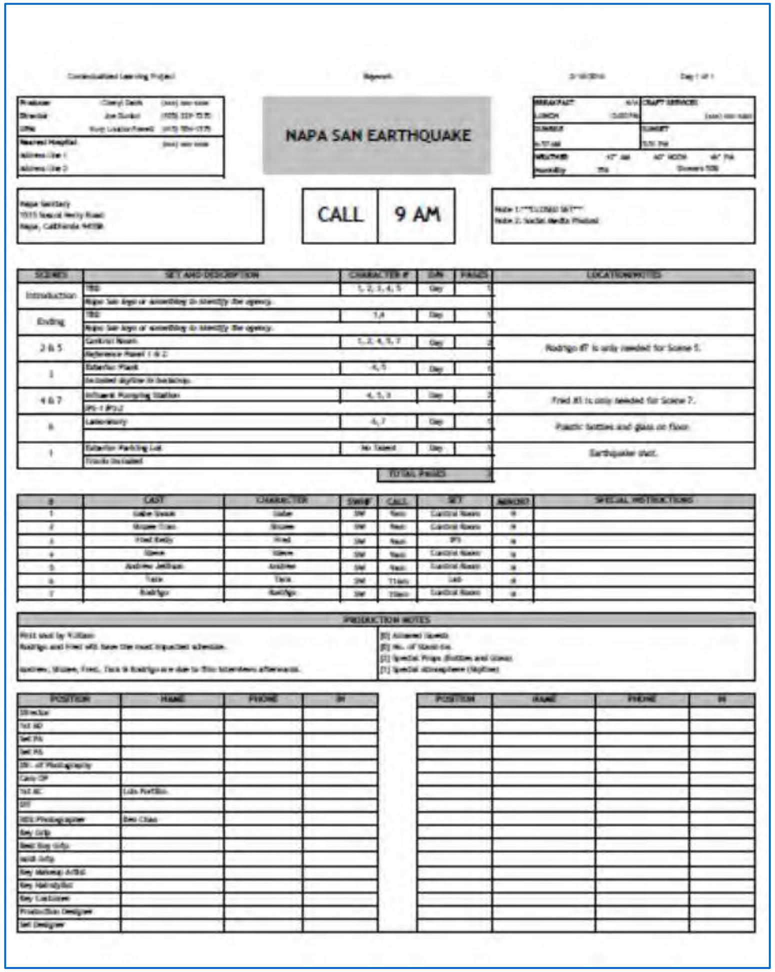
- Gabe and Andrew

Shoot 6: SCENE 7: Pumping Station

- Andrew and Steve

Shoot 7: SCENE 6: Lab

- Tara



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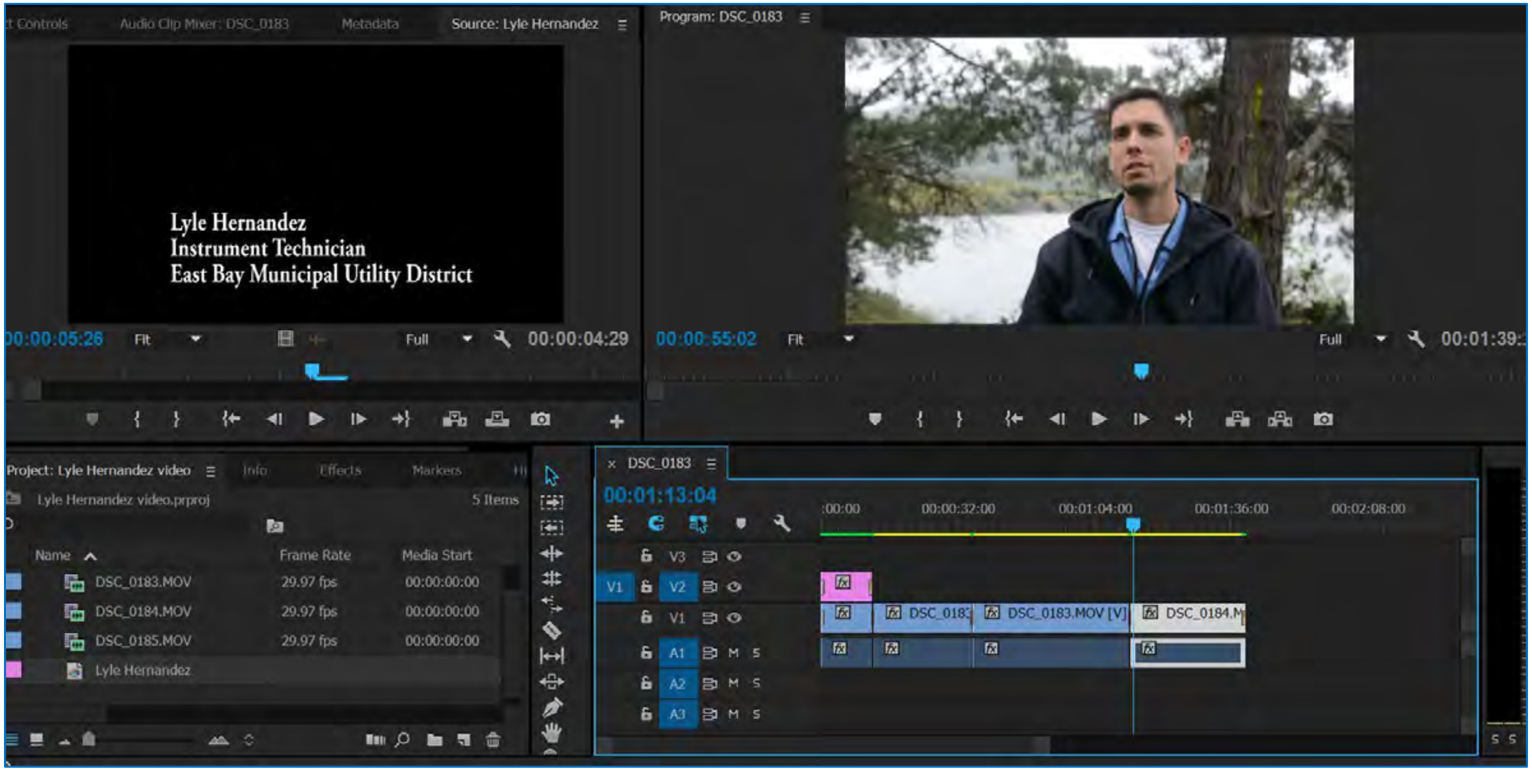
Film and video editing software

- ➢ **Premiere Pro - Creative Cloud**



Contextualized Learning Project

Hardware:

- Nikon D-5200 camera
- Tripod
- Clip-on mini-microphone

Future:

- Video camera
- Boom
- Second mini-mike

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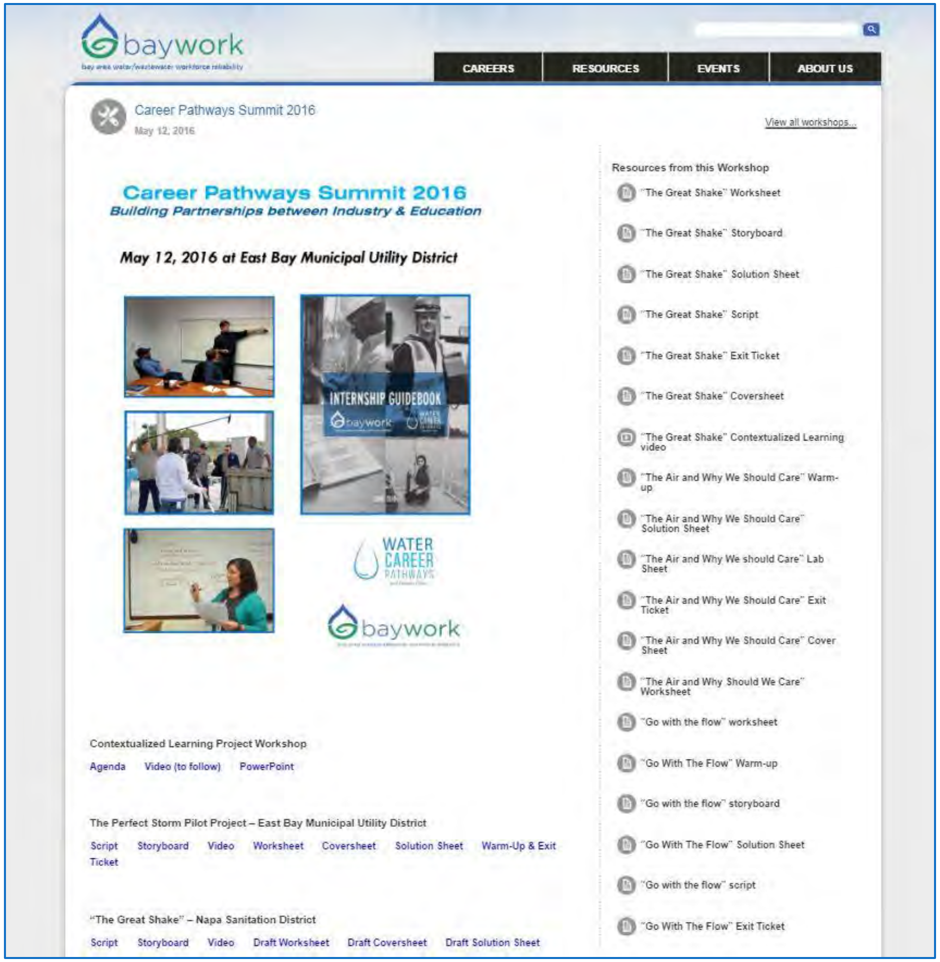
Contextualized Learning Project

baywork.org



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Contextualized Learning Project

Future:

- Continue to upgrade products we produce
- Involve more agencies and staff from other industries in creating contextualized learning modules
- Help teachers learn how to integrate modules into their lesson plans
- Put modules online for easy access

Contextualized Learning Project

Our Goal

To create a learning community with subject matter experts and educators working together for the next generation

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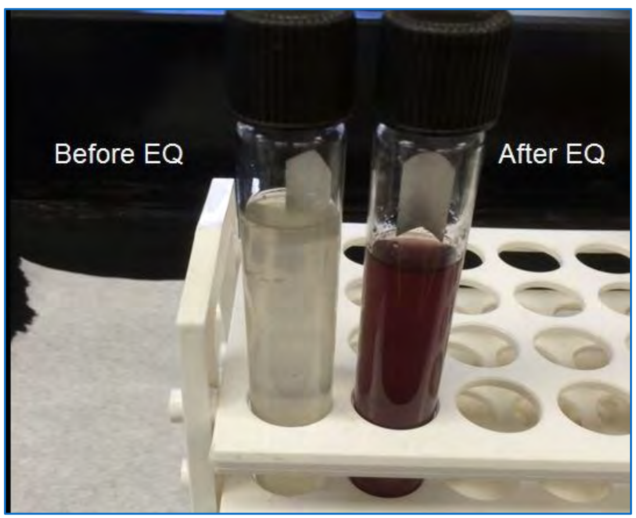
“The Great Shake” Napa Sanitation District



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“The Great Shake” Napa Sanitation District

Subject Matter Expert –
Jim Keller, Napa Sanitation District

- **Who I am**
- **Why I wanted to participate**
- **Products**

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“The Great Shake” Napa Sanitation District

Script

Napa Sanitation Earthquake - Video Script

Cast: Gabe – Control Room Operator Lead

Stand-in (diversity stand-in from Levi) – Panel Operator (SCADA)

Steve – Investigating Operator Lead

Andrew – OIT (Operator in Training)

Tara – Laboratory Chemist/Biologist

Rodrigo – Laboratory Chemist/Biologist/Bi-Lingual

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.

Gabe : I’m Gabe Snook. I’m also an Operator III with the District. In addition to what Steve said we also produce recycled water for use in irrigation. Additionally, we put the biosolids we capture and the enrgy that’s created into beneficial resuse. I guess you can say we are a resource recovery facility.

Andrew: I’m Andrew Jellison. I’m working at the District as an “Operator in Training” gaining qualified work experience as a Wastewater Operator.

Stand-In: Hi I’m________________

Steve: We use math on a regular basis in the operation of our treatment plant to make sure they are working right and to tell us if changes need to be made.

Gabe : We thought we could share with you how we used math to help us through the earthquake we had in August 2014.

Scene 1

Open with video of parking lot and trucks.

When trucks start shaking show text “ Napa Sanitation District Earthquake August 2014”

Scene 2 Control Room (Reference pictures Panel- 1, Panel- 2)

Show control room Gabe and Panel Operator at console.

Focus Gabe on phone, “They’re saying it was a 6.1 centered on the other side of the River…. No, so far we found no damage and the plant is operating well… I’ll keep you informed.” Hangs up.

WATER CAREER PATHWAYS

Your Future is Clear.

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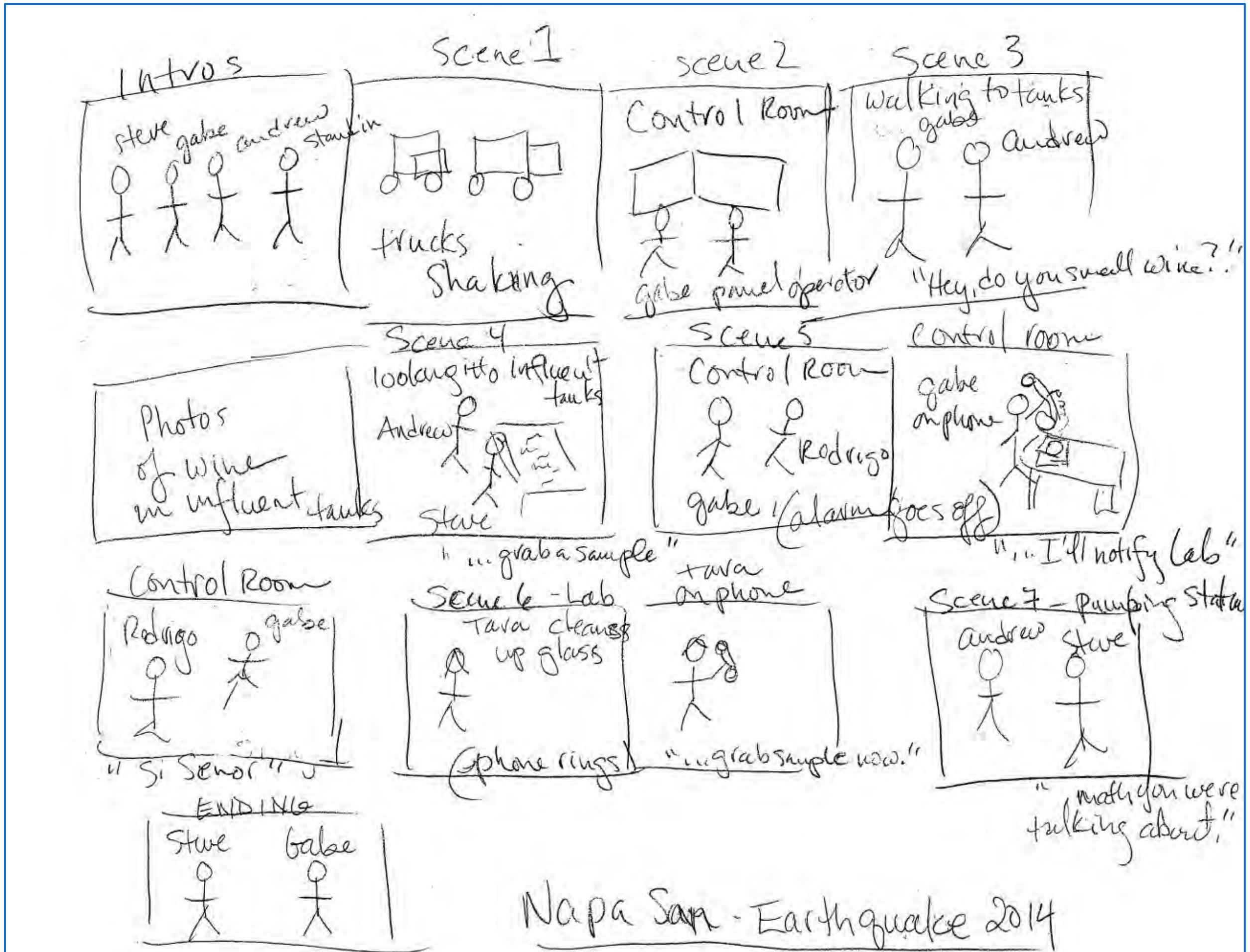
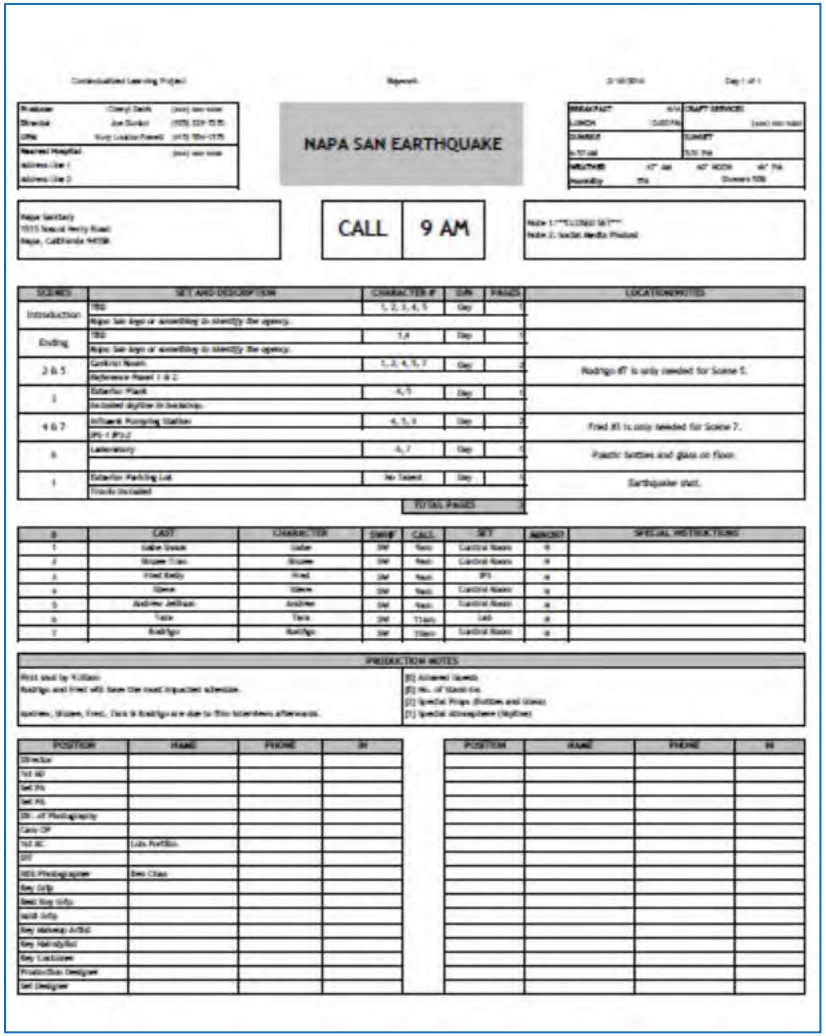
"The Great Shake" Napa Sanitation District

Storyboard



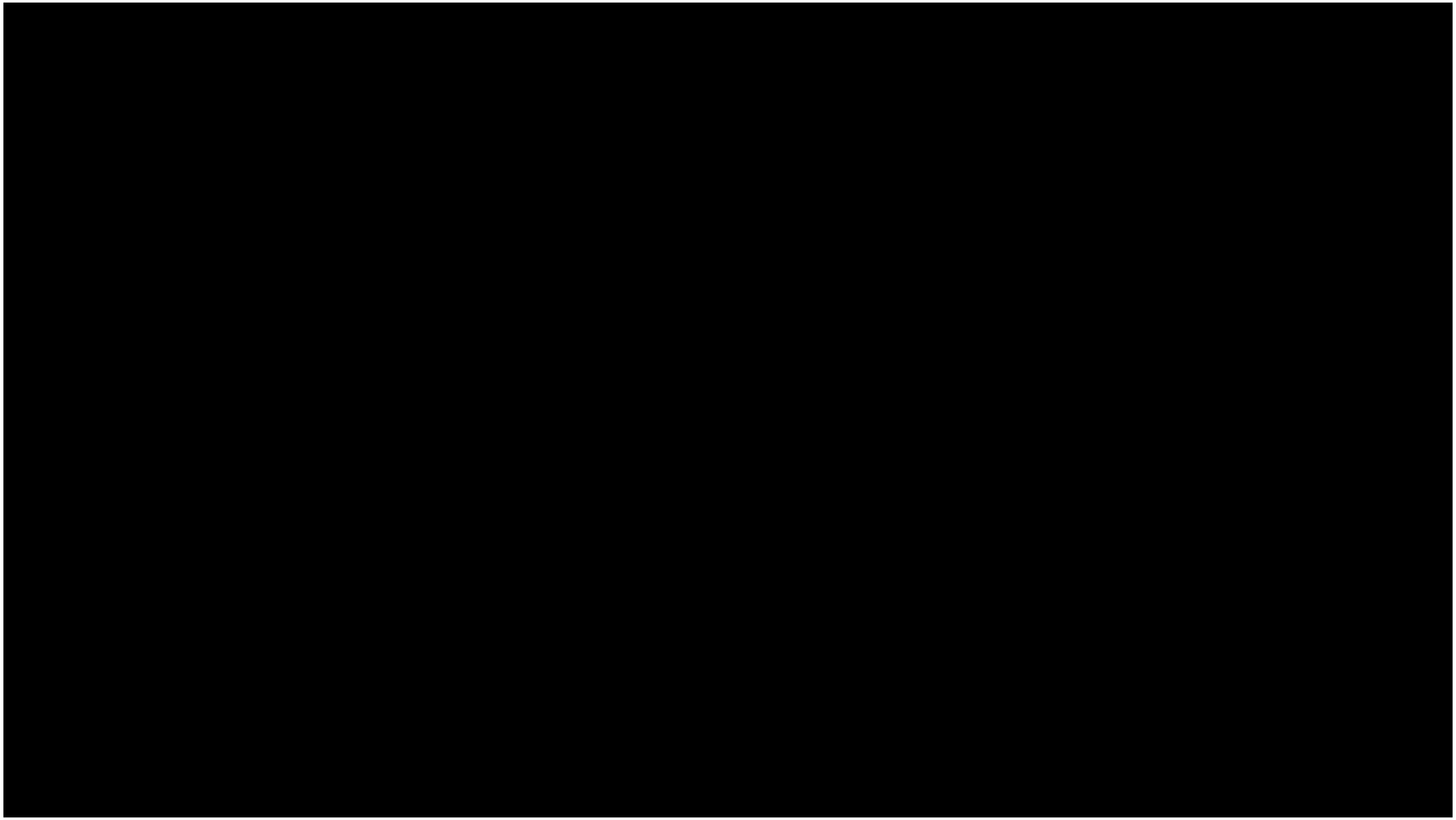
"The Great Shake" Napa Sanitation District

Call sheet



“The Great Shake” Napa Sanitation District

Video



WATER CAREER PATHWAYS
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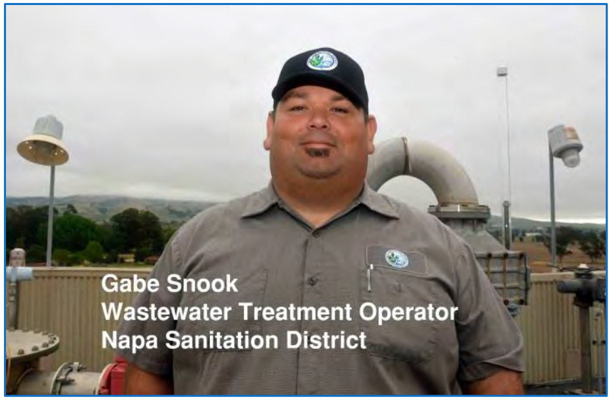
"The Great Shake" Napa Sanitary District

Candidate Development Videos



WATER CAREER PATHWAYS
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"The Great Shake" Napa Sanitation District

Instructional Designer –
Levi Fuller, Dublin San Ramon Services District

- Who I am
- Why I wanted to participate
- Products

Curriculum Deliverables

Warm-up for students

The Napa "Great Shake" WARM-UP

Calculating hydraulic detention time and organic loading are two important factors treatment plant operators have to understand in order to operate a wastewater treatment plant.

Hydraulic detention time (HDT) also known as hydraulic retention time (HRT) is a measure of the average length of time that a compound (in this case wastewater) remains in a treatment tank or unit. Simply stated if you started to fill a tank with wastewater the detention time is the average amount of a time that a drop of that water will remain in the treatment tank before the tank fills and that drop of water flows out of it. This is important because as wastewater passes through a treatment tank it must stay in the tank for the necessary period of time in order to be adequately treated. For example, in most aeration treatment systems, 4 to 8 hours of detention time is necessary in order for the microorganisms in the aeration system to absorb, adsorb and remove the contaminants (bacteria food) in the wastewater.

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 (Biochemical Oxygen Demand) which is a test run in a lab which measures the concentration or strength of the organic loading of a volume of wastewater. Think of the BOD or organic load as wastewater contamination which serves as bacteria food that the microorganisms in the treatment system consume and remove from the wastewater. Treatment plant operators must understand the relationship between the contaminant (organic load) in the wastewater relative to the amount of microorganisms in the treatment system that are available to remove that organic load. Therefore, operators must calculate the pounds of organic load contained in a volume of wastewater then calculate the pounds of microorganisms that are in the treatment system which is available to consume and remove the organic load. The operator then compares the pounds of organic loading to the pounds of microorganisms. This comparison 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. 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.

1. **Hydraulic Detention Time**

   A. Calculate the Hydraulic Detention Time in a treatment tank given the following:

Flow to a rectangular aeration basin is 3.0 million gallons per day. The clarifier is 100 ft in length, 50 ft wide, and 15 ft deep. Calculate the aeration basin's hydraulic detention time.

Volume of Rectangular or circular tank of uniform depth, (ft^3) = area, $(ft)^2$ x depth, (ft)

$$\text{Detention time, (hr)} = \left[\frac{\text{tank volume, } (ft^3) \times 7.5 \left(\frac{gallons}{ft^3}\right) \times 24 \left(\frac{hr}{day}\right)}{\text{Q, (gallons/day)}}\right]$$

   B. Is this an adequate amount of treatment time?

WATER CAREER PATHWAYS
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Curriculum Deliverables

Coversheet for teachers

The Napa "Great Shake" Coversheet

Introduction: The following lessons introduce students to algebra equations in order to determine hydraulic detention time, 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.

Curriculum Deliverables

Equivalents and formulas sheet

STATE WATER RESOURCES CONTROL BOARD
OPERATOR CERTIFICATION EXAMINATION
Equivalents and Formulae Sheet (Revised Jan 2014)

EQUIVALENTS

Note: conc = concentration, L = liter, mg = milligram, ppm = parts per million, psi = lbs/in^2

27 ft^3 = 1 $yard^3$ 1 acre = 43,560 ft^2 1 ft^3 of water = 7.48 gallons 1 gallon of water = 8.34 lbs 365 days = 1 year	1 gram = 1,000 mg 1 ton = 2,000 lbs 1 mg/L = 1 ppm 1 % = 10,000 mg/L π = 3.14	60 min = 1 hour 24 hours = 1 day 1 day = 1,440 min = 86,400 sec 1 ft of H_2O = 0.43 psi 1 lbs/in^2 = 2.31 ft of H_2O
1 HP = 0.746 kW = 550 ft·lb/sec = 33,000 ft-lb/min		
1 Million Gallons/Day (MGD) = 694 Gallons/Minute (gpm) = 1.547 ft^3/sec = 3.069 acre·ft/day		

FORMULAS

Acronym: AST = Activated Sludge Tank, BOD = Biochemical Oxygen Demand, ET = Evapotranspiration, F/M = Food to Micro-organism Ratio, HP = Horsepower, kW = Kilo-Watt, MCRT = Mean Cell Residence Time, MG = Million Gallons, MLSS = Mixed Liquor Suspended Solids, MLVSS = Mixed Liquor Volatile Suspended Solids, Q = flow, RBC = Rotating Biological Contactor, SS = Suspended Solids, TDH = Total Dynamic Head, TF = Trickling Filter, VS = Volatile Solids, WAS = Waste Activated Sludge

Area of Rectangle, $\{ft^2\}$ = length, {ft} x width, {ft}
Area of Circle, $\{ft^2\} = \frac{\pi}{4} \times [\text{diameter}, \{ft\}]^2 = 0.785 \times [\text{diameter}, \{ft\}]^2$
Volume of Rectangular or circular tank of uniform depth, $\{ft^3\}$ = area, $\{ft\}^2$ x depth, {ft}
Volume of Cone, $\{ft^3\} = \left[\frac{\text{base area}, \{ft^2\} \times \text{depth}, \{ft\}}{3}\right]$
Circumference, {ft} = π x diameter, {ft}
Removal efficiency, $\{\%\} = \left[\frac{(\text{in}-\text{out})}{\text{in}}\right] x100$
Velocity, $\{ft/sec\} = \left[\frac{\text{distance},\{ft\}}{\text{time},\{sec\}}\right]$
Detention time, $\{hr\} = \left[\frac{\text{tank volume}, \{ft^3\} \text{ X } 7.5 \{\frac{\text{gallons}}{ft^3}\} \text{ X } 24\{\frac{\text{hrs}}{\text{day}}\}}{\text{Q}, \{\text{gallons/day}\}}\right]$
Q, $\{ft^3/sec\}$ = velocity {ft/sec} x area $\{ft^2\}$
BOD or SS, {lbs/day} = 8.34 {lbs·L/MG·mg} x Q,{MGD} x conc,{mg/L}
Hydraulic loading rate, $\{gal/day \cdot ft^2\} = \left[\frac{\text{Q total}, \{\text{gallons/day}\}}{\text{area}, \{ft^2\}}\right]$
Digester (VS) loading rate, $\{lbsVS/day \cdot ft^3\} = \left[\frac{\text{VS added}, \{\text{lbs/day}\}}{\text{volume}, \{ft^3\}}\right]$
Weir overflow rate, $\{gal/day \cdot ft\} = \left[\frac{\text{Q}, \{\text{gallons/day}\}}{\text{weir length}, \{ft\}}\right]$
Solids loading rate, $\{lbs/day \cdot ft^2\} = \left[\frac{\text{solids applied}, \{\text{lbs/day}\}}{\text{surface area}, \{ft^2\}}\right]$
F/M, {lbs BOD/day·lbs MLVSS} = $\frac{\text{BOD applied (lbs/day)}}{\text{MLVSS}, \{\text{lbs}\}}$

Curriculum Deliverables

Worksheet for students

The Napa "Great Shake" Worksheet

Wastewater treatment plant operators have to make numerous calculations in order to make adjustments to treatment processes in order to produce well treated water that can be safely placed back into the environment. Two of those calculations are hydraulic detention time which is a measure of the average amount of time a volume of wastewater is in a treatment unit. Wastewater treatment plants use microorganisms in the treatment process. These microorganisms consume contaminants in the wastewater using that contamination as their food source. Operators most insure that there is the proper amount of microorganisms to remove the contaminants in the incoming wastewater. Therefore, wastewater operators must calculate the food to microorganism (F/M) ratio. F/M ratio is a calculation that compares pounds of contamination in volume of wastewater to the pounds of microorganisms in a wastewater treatment tank that are available to consume and remove that contamination.

The City of Napa Wastewater Treatment Plant operates well with a determined hydraulic detention time and organic loading rate (Food/Microorganism Ratio). As a result of the Napa Earthquake staff estimates that approximately 360,000 gallons of wine spilled and made its way into the wastewater treatment plant. This 360,000 gallons increased both the detention and organic loading (Food to Microorganisms ratio).

If we assume the following:

Normal Flow: 6 million gallons per day

Normal Flow BOD: 250 mg/l

Aeration Total Volume: 3 million gallons

Aeration Mixed Liquor Suspended Solids: 2500 mg/l

Volatile Content: 81% (% of material in the treatment unit that is organic. i.e. bacteria)

Normal Detention Time: 4.5 hours

Normal Food/Microorganism Ratio: 0.24

WATER CAREER PATHWAYS
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Curriculum Deliverables

Solution sheet for teachers

The Napa "Great Shake" Solution Sheet

WARM-UP

Calculating hydraulic detention time and organic loading are two important factors treatment plant operators have to understand in order to operate a wastewater treatment plant.

Hydraulic detention time (HDT) also known as hydraulic retention time (HRT) is a measure of the average length of time that a compound (in this case wastewater) remains in a treatment tank or unit. Simply stated if you started to fill a tank with wastewater the detention time is the average amount of a time that a drop of that water will remain in the treatment tank before the tank fills and that drop of water flows out of it. This is important because as wastewater passes through a treatment tank it must stay in the tank for the necessary period of time in order to be adequately treated. For example, in most aeration treatment systems, 4 to 8 hours of detention time is necessary in order for the microorganisms in the aeration system to absorb, adsorb and remove the contaminants (bacteria food) in the wastewater.

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 (Biochemical Oxygen Demand) which is a test run in a lab which measures the concentration or strength of the organic loading of a volume of wastewater. Think of the BOD or organic load as wastewater contamination which serves as bacteria food that the microorganisms in the treatment system consume and remove from the wastewater. Treatment plant operators must understand the relationship between the contaminant (organic load) in the wastewater relative to the amount of microorganisms in the treatment system that are available to remove that organic load. Therefore, operators must calculate the pounds of organic load contained in a volume of wastewater then calculate the pounds of microorganisms that are in the treatment system which is available to consume and remove the organic load. The operator then compares the pounds of organic loading to the pounds of microorganisms. This comparison 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. 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.

1. Hydraulic Detention Time

A. Calculate the Hydraulic Detention Time in a treatment tank given the following:

Flow to a rectangular aeration basin is 3.0 million gallons per day. The clarifier is 100 ft in length, 50 ft wide, and 15 ft deep. Calculate the aeration basin's hydraulic detention time.

$$\frac{(100 \times 50 \times 15)\ ft3 \ * \ 7.5\ gal/ft3 \ * \ 24\ hrs/day}{3{,}000{,}0000\ gal/day}$$

$$\frac{75000\ ft3 * 7.5\ gal/ft3 * 24\ hrs/day}{3{,}000{,}000\ gal/day}$$

$$\frac{13{,}500{,}000\ gal/hrs/day}{} = 4.5hrs$$

Curriculum Deliverables

Exit ticket for students

Exit Ticket

1. What is the importance of detention time in a treatment tank?
2. What is the significance or meaning of organic loading in a biological treatment process like one might find in a wastewater treatment plant?
3. What is food to microorganism ratio?
4. Why is food to microorganism ratio important?
5. How could a spill of wine impact the biological treatment process like one might find in a wastewater treatment plant?

"The Great Shake" Napa Sanitation District

Panel Discussion

"Go with the Flow" EBMUD

WATER CAREER PATHWAYS
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"Go with the Flow" EBMUD

Subject Matter Expert –
Jim Smith, EBMUD

- Who I am
- Why I wanted to participate
- Products

WATER CAREER PATHWAYS
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"Go with the Flow" EBMUD

Script

1

VIDEO	AUDIO
SCENE 1 - INTRO IN CONTROL ROOM: Scene opens with a two-shot of Maria and Andrew	MARIA "Hi. My name is Maria Rodriguez and I'm a Senior Water treatment Operator at The East Bay Municipal Utility District or East Bay Mud. Our work is very important for our community and the environment. At East Bay Mud we operate six water treatment plants to provide clean drinking water for 1.4 million people." ANDREW "I'm Andrew Kwan, and I'm also a Senior Water Treatment Operator with the District. Water treatment operators are public health workers and our plants are staffed 24 hours per day 7 days a week to ensure that you always have safe water." MARIA "We believe our jobs very important and take continuing education classes each year to improve our skills. But to get entry-level jobs in water treatment it is necessary to have strong math skills, because we use math on a regular basis to make sure the water is property treated." ANDREW "To give you an idea of how important math is for our work, we want to share information about how math helped us keep water flowing at a constant rate and maintain excellent water quality steady when we needed to make a repair at the plant a few months ago." MARIA "Even when we need to make a repair or do maintenance at the plant, we can never let down our customers. We'd like to show you an example of the math it takes to provide reliable water service."

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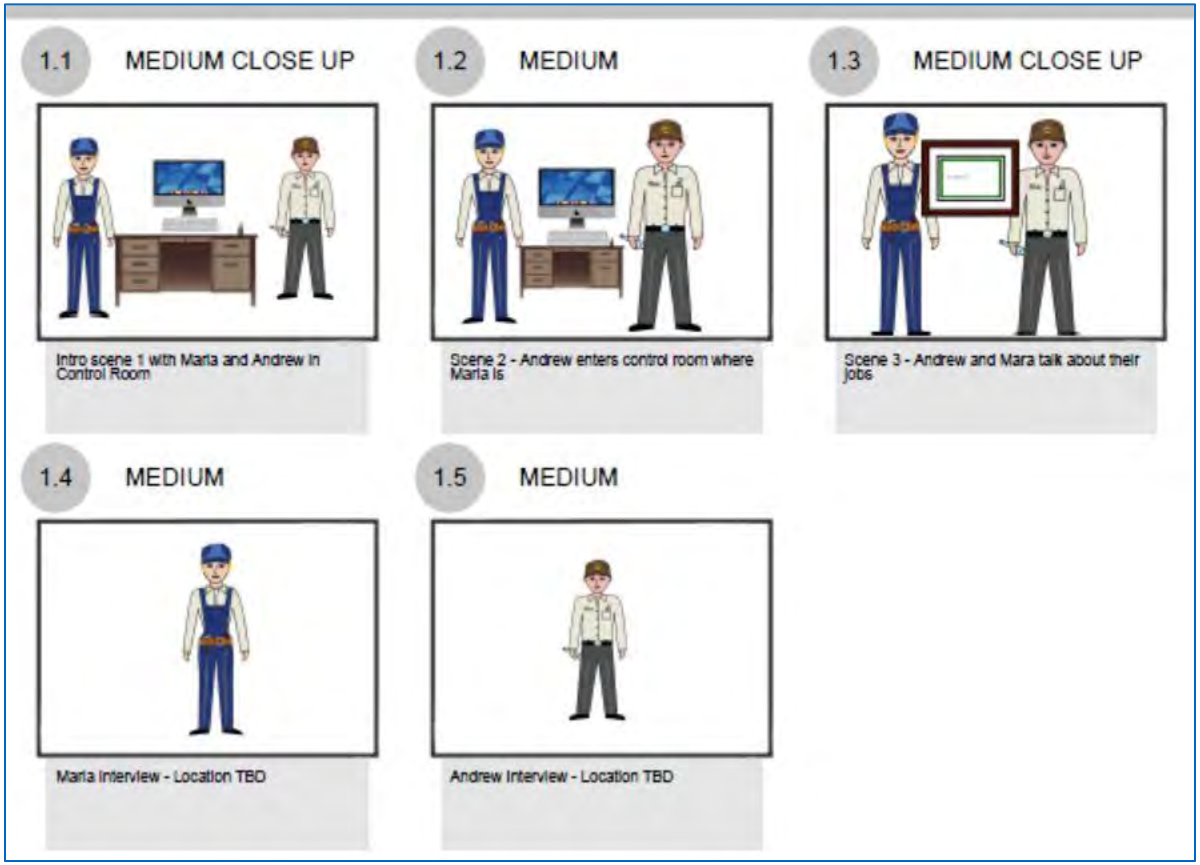
"Go with the Flow" EBMUD

Storyboard



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"Go with the Flow" EBMUD

Video

WATER CAREER PATHWAYS
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"Go with the Flow" EBMUD

Candidate Development Videos

WATER CAREER PATHWAYS

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"Go with the Flow" EBMUD

Instructional Designer –
Kathi Roisen, Laney College

- Who I am
- Why I wanted to participate
- Products

Curriculum Deliverables

Warm-up

GO WITH THE FLOW

WARM-UP

1) A water reservoir at EBMUD has a volume of 11,454 $\frac{5}{8}$ cubic feet.

   What are the possible dimensions of this reservoir?

   a) 11 ft wide 45 ft long 4 $\frac{5}{8}$ ft deep

   b) 22.75 ft wide 38 ft long 14.25 ft deep

   c) cannot be calculated

   d) 13 ¼ ft wide 22 ¾ ft deep 38 ft long

2) Convert 15 million gallons per day to gallons per minute.

WATER CAREER PATHWAYS
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Curriculum Deliverables

Coversheet for teachers

Background for Instructors and Students "Go with the Flow"

Water and wastewater treatment plants process very large quantities of water, sometimes 20-35 million gallons per day or more, depending on the size of the cities they service. Water Treatment Operators have to know ***how long*** it will take for water to get from one place to another based on "flow rate", which is measured in millions of gallons per day (MGD). The time it takes for water to flow from one end of a pipe or tank to the other is called "detention time".

Water Treatment Operators introduce chemicals into the water supply to remove the particles in the water and to disinfect it so it is safe to drink. Have you had the experience of being in water that has been treated? Well, if you've ever been in a pool then you have been in water treated with chlorine.

Wastewater treatment facilities must treat enormous quantities of water with very specific quantities and combinations of chemicals at very precise moments in time as the water flows from the beginning to the end of the treatment plant. Therefore the plant operators who are responsible for treating the water must be able to calculate the volume of water and the speed at which it moves from one place to another.

Here are some terms and mathematical concepts that must be understood before a student can make these flow rate calculations accurately:

Volume: In this context we will be talking about square or rectangular basins. (see additional problem below to deepen learning and consider a cylindrical pipe)

The volume of water in a rectangular basin is obtained by calculating the product of the length and width of the basin and then multiplying that figure by the height of the water. Notice, the height of the water is not the same as the height of the tank.

Conversion: 7.48 gallons of water = 1 cubic ft.

Therefore 1 gallon of water occupies 0.133689 cubic feet. (Do you see how we obtained this number?)

If we calculate the volume of a basin in cubic feet, we can easily convert that volume number to gallons. In other words we can find out how many gallons would occupy a certain sized container.

If you are given flow rate in terms of gallons per ***day***, can you convert that number to gallons per ***hour***? How? What about gallons per ***minute*** or gallons per ***second?***

Now imagine a fixed quantity of water flowing through a basin...would the water flow more quickly or more slowly if the basin were smaller? Are you sure? How can you test this hypothesis?

WATER CAREER PATHWAYS
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Curriculum Deliverables

Worksheet for students

GO WITH THE FLOW

Worksheet for Students

Consider a water treatment plant that has two rectangular basins. The basins are next to each other, side by side. The raw water from a lake or river flows into the plant and is divided equally into the two basins. We will refer to these as Basin 1 and Basin 2. Basin 1 mixes the treatment chemicals to coagulate the particles in the water, and Basin 2 allows the coagulated dirt in the raw water to sink to the bottom of the basin. Basin 1 measures 62 feet-6 inches wide, 64 feet-6 inches long and 16 feet-6 inches tall. This basin contains 14 feet-9 inches of water. Basin 2 is 67 feet wide, 211 feet-6 inches long, and 18 feet-6 inches deep. This basin contains 16 feet-6 inches of water. **The flow in each basin is 9.5 million gallons per day (MGD).**

How long will it take for the water to flow from:

1) The beginning of the Basin 1 to the end of the Basin 1?

2) The beginning of the Basin 2 to the end of the Basin 2?

3) The beginning of the Basin 1 to the end of Basin 2?

If the plant had a problem and needed to take a basin out of service to clean or repair it, as discussed in the video, this would have an impact on detention time. The entire plant flow of 19 MGD would have to flow through one basin instead of two.

4) How would this change the detention time through that one remaining basin? [assume basin 1 has been taken out of service]

WATER CAREER PATHWAYS
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Curriculum Deliverables

Solution sheet for teachers

GO WITH THE FLOW

Solution Sheet

Question 1: Calculate the volume and detention time of Basin 1 at a flow rate of 9.5 MGD:

Volume is length*width * height (water level) = (64.5 ft)*(62.5 ft)* (14.75 ft) =59,461 cu. ft.

How many gallons can 59,461 cu. ft hold?

(7.48 gallons/cu. ft) x (59,461 cu. ft) = 444,768 gallons in Basin 1.

Flow rate is 9.5 million gallons/day = 9,500,000 gallons/day *day/24 hours*hour/60 minutes = 6,597 gallons per minute (hint: how many minutes are in a day?)

So 444,768 gallons ÷ 6,597 gallons per minute = 67.4 minutes

This means that at a flow rate of 9.5 million gallons per day (which is equivalent to 6597 gallons per minute) all the water in Basin 1, which is 444,768 gallons, can get processed in 67.4 minutes

Question 2: Calculate the volume and detention time of the Basin 2 at a flow rate of 9.5 MGD:

Volume is length*width * height (water level) = (211.5 ft)*(67.0 ft)* (16.5 ft) =233,813 cu. ft.

How many gallons can 233,813 cu. ft hold?

(7.48 gallons/cu.ft) x (233,813 cu. ft) = 1,748,923 gallons in Basin 2

Flow rate is 9.5 million gallons/day = 9,500,000 gallons/day *day/24 hours*hour/60 minutes = 6,597 gallons per minute

So 1,748,923 gallons ÷ 6,597 gallons per minute = 265.1 minutes or 4.4 hours

Question 3: Calculate the detention time from the beginning of Basin 1 to the end of Basin 2 at 9.5 MGD:

The detention time of Basin 1 at 9.5 MGD is 67.4 minutes.

The detention time of Basin 2 at 9.5 MGD is 265.1 minutes.

265.1 minutes + 67.4 minutes = 332.5 minutes or 5.5 hours

Question 4: Since the flow would increase from 9.5 MGD to 19 MGD the flow would double. Do you see why? The plant cannot decide to treat less water, they just have to reroute the water thorough the basins that are available.

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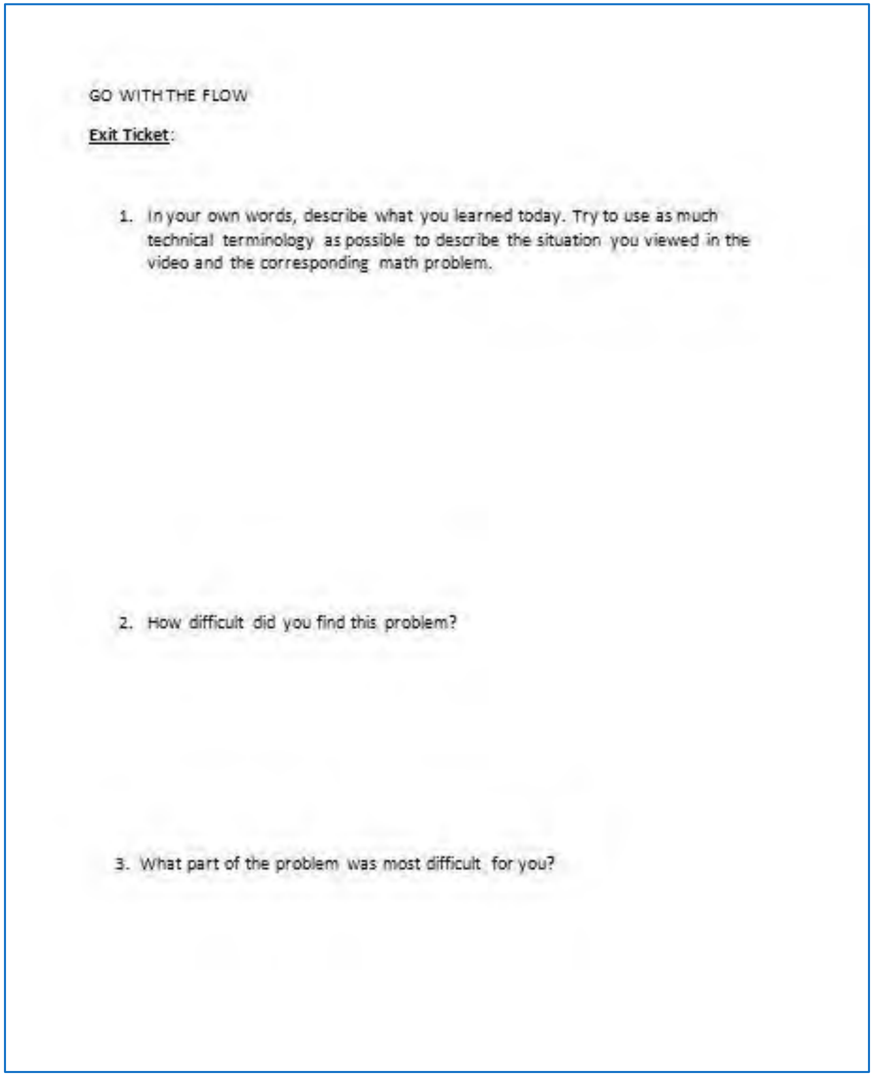
Curriculum Deliverables

Exit ticket


GO WITH THE FLOW

Exit Ticket:

1. In your own words, describe what you learned today. Try to use as much technical terminology as possible to describe the situation you viewed in the video and the corresponding math problem.

2. How difficult did you find this problem?

3. What part of the problem was most difficult for you?

Panel Discussion

"Under Pressure" EBMUD

WATER CAREER PATHWAYS
Your Future is Clear.

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“Under Pressure” EBMUD

Subject Matter Expert –
Lyle Hernandez, EBMUD

- Who I am
- Why I wanted to participate
- Products

WATER CAREER PATHWAYS
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"Under Pressure" EBMUD

Script

VIDEO	AUDIO
INTRODUCTION: Briones Reservoir (Bear Creek Road) Show service area map while Lyle is describing the service area	LYLE HERNANDEZ KYLE TERRY LYLE HERNANDEZ Hi, my name is Lyle Hernandez. I'm an instrument technician at EBMUD. KYLE TERRY Hey, my name is Kyle Terry. I'm an instrument worker III at EBMUD. We help to provide high quality drinking water for 1.3 million east bay residents. LYLE HERNANDEZ Our service area encompasses a 331 square mile area from Crockett in the north, south to San Lorenzo, east to Walnut Creek, and south from Walnut Creek to San Ramon. KYLE TERRY We use math on a daily basis in the various jobs we're required to perform. LYLE HERNANDEZ Next, we'd like to show you an example of what one of these jobs would look like.
SCENE 1 - AMC INSTRUMENT OFFICE: Kyle looking at work order program on computer screen at desk. Kyle's phone rings. Cut to Lyle looking at the same work order program.	KYLE TERRY Kyle Terry, East Bay MUD. LYLE HERNANDEZ What's up Kyle? KYLE TERRY What's going on Lyle? LYLE HERNANDEZ The control center says the foot gauge doesn't match the level transmitter at Berkeley View Reservoir.

“Under Pressure” EBMUD

Location Scouting

WATER CAREER PATHWAYS

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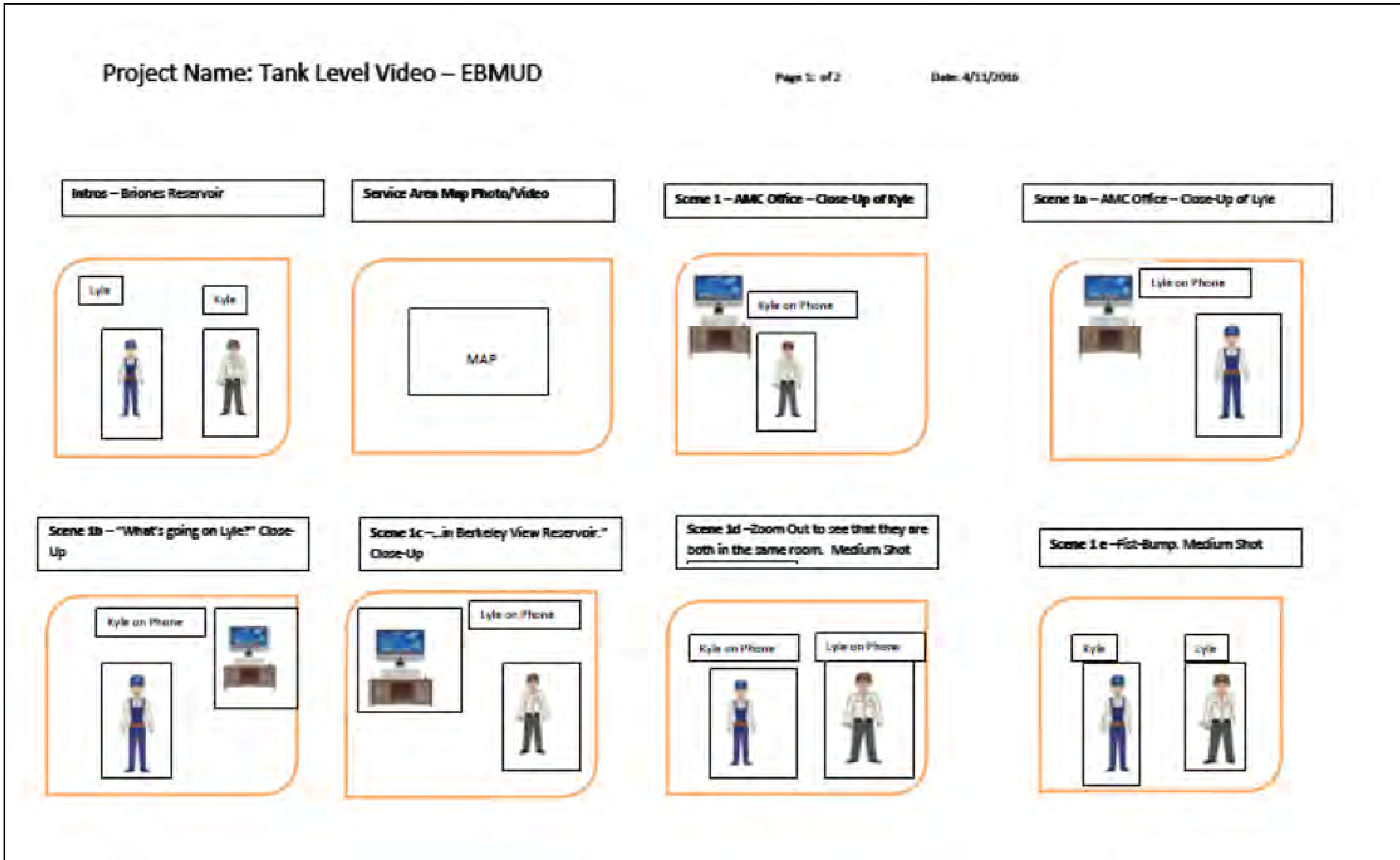
“Under Pressure” EBMUD

Storyboard



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"Under Pressure" EBMUD

Call Sheet

"Under Pressure" call sheet

Adeline Maintenance Center, 1100 21 st. Oakland CA

April 26. 2016

9 a.m. call time

Lyle Hernandez

Kyle Terry

Shoot 1 – Scene 1 AMC office

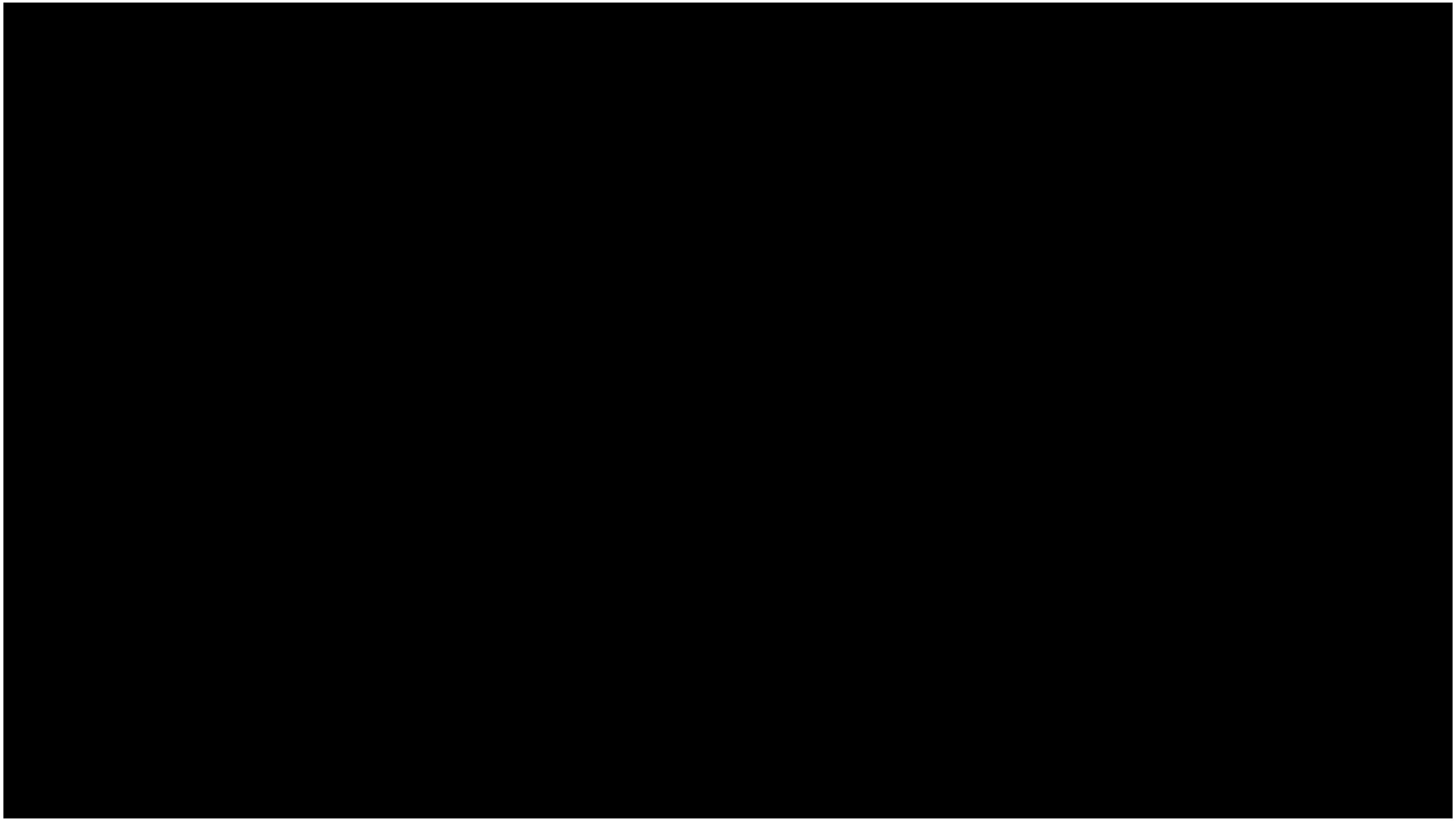
Shoot 2 - Scene 2 Packing Van - Van drives away

Shoot 3 – Scene 3 Berkeley Reservoir – Van arrives, Pit calibration

Shoot 4 - Briones Reservoir – Ending and Intro and interviews.

“Under Pressure” EBMUD

Draft Video



WATER CAREER PATHWAYS
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"Under Pressure" EBMUD

Candidate Development Videos

"Under Pressure" EBMUD

Instructional Designer –
Kathi Roisen, Laney College

- Who I am
- Why I wanted to participate
- Products

Curriculum Deliverables

Warm-up

1) If a tank that measures 120 inches in height is 65% full, how many inches of water does it contain? Express your answer two ways: in inches as well as in feet.

2) The volume of a cylindrical water tank is 3500 cu. ft.

   a. How many gallons of water can it hold at full capacity?

   b. What is the tank's diameter if the height is 10 ft?

Curriculum Deliverables

Coversheet for Teachers

We need to discuss these topics first:

- Why water distribution operators must be able to determine how much water is in their tanks at all times
- How are water levels read on measuring devices?
- Basic concepts like inches of water and pressure (PSI)
- Students must be able to calculate percentages

Curriculum Deliverables

Worksheet for Students – The Math Problem

A water tank has a height of 300 inches and a diameter of 30 feet.
A water distribution operator's computer screen shows that the reservoir (aka "tank") is 75% full.

a. How many inches of water should we measure at the bottom of the reservoir?

b. How many feet of water?

c. How many PSI?

d. What is the maximum capacity (in gallons of water) of the reservoir?

e. If the reservoir is 75% full how many gallons are in it?

f. The level indicator on the side of the reservoir reads 25% full. There is a gauge at the bottom of the tank which reads 5.1 PSI. Is the gauge reading accurately? If not, what should the gauge be reading?

Curriculum Deliverables

Solution Sheet for Teachers

a. 225 inches

b. 18.75 ft.

c. 8.12 PSI

d. 132,182.4 gallons

e. 99,136.8 gallons

f. NO. The gauge should read 2.71 PSI

Curriculum Deliverables

Exit Ticket

- In your own words, describe what you learned today. Try to use as much precise technical terminology as possible.
- How difficult did you find this problem?
- What part of this problem was most difficult for you?
- If this problem was not particularly difficult for you, why do you think that is the case?

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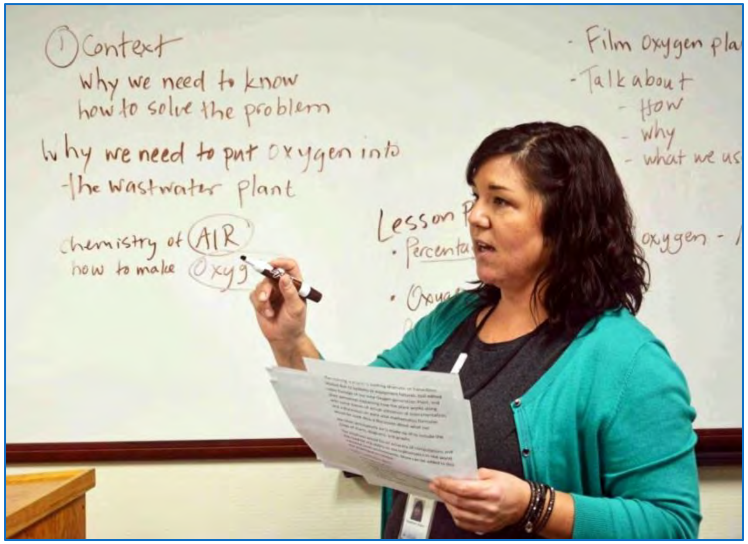
“Under Pressure” EBMUD

Panel Discussion

"The Air & Why We Should Care" SFPUC



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“The Air & Why We Should Care” SFPUC

Subject Matter Expert –
Susan Tensfeldt, San Francisco Public Utilities Commission

- **Who I am**
- **Why I wanted to participate**
- **Products**

"The Air & Why We Should Care" SFPUC

Script

1

VIDEO	AUDIO
CHARACTERS:	**CHARLES JOHNSON** **STEVE ARDREY** **LOLITA WILKINS**
SCENE 1: INTRODUCTION WITH THE ENTIRE CAST: **Scene Detail:** In the DOC - in front of the DCS screen at the plant - Steve, Charles and Lolita are standing in front of the DCS screen.	STEVE ARDREY "Hello my name is Steve Ardrey; I am the Field Supervisor for the Instrumentation and Controls Department at the wastewater treatment plant in San Francisco. This display is an overview of our wastewater treatment process from incoming influent wastewater flow, to effluent outgoing flow. The treatment of wastewater is critical for our personal health and environment. In a moment we will show you how chemistry and mathematics play a vital role in monitoring and controlling a wastewater treatment process." CHARLES JOHNSON "Hello my name is Charles Johnson. I am an Instrumentation and Controls Technician at the Southeast Wastewater Treatment Plant in San Francisco. Part of our wastewater treatment process is to provide pure oxygen to the incoming wastewater to aid in the breakdown of organic materials in the water. This is a display of our oxygen generation plant. The Oxygen generation plant produces 91 to 95 percent pure oxygen. The oxygen produced is channeled to the Aeration tanks to aid in the breakdown of organic materials in the wastewater." LOLITA WILKINS "Hello, I am Lolita Wilkins. I am a Wastewater Treatment Plant Operator at the Southeast Treatment Plant in

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"The Air & Why We Should Care" SFPUC

Location Scouting

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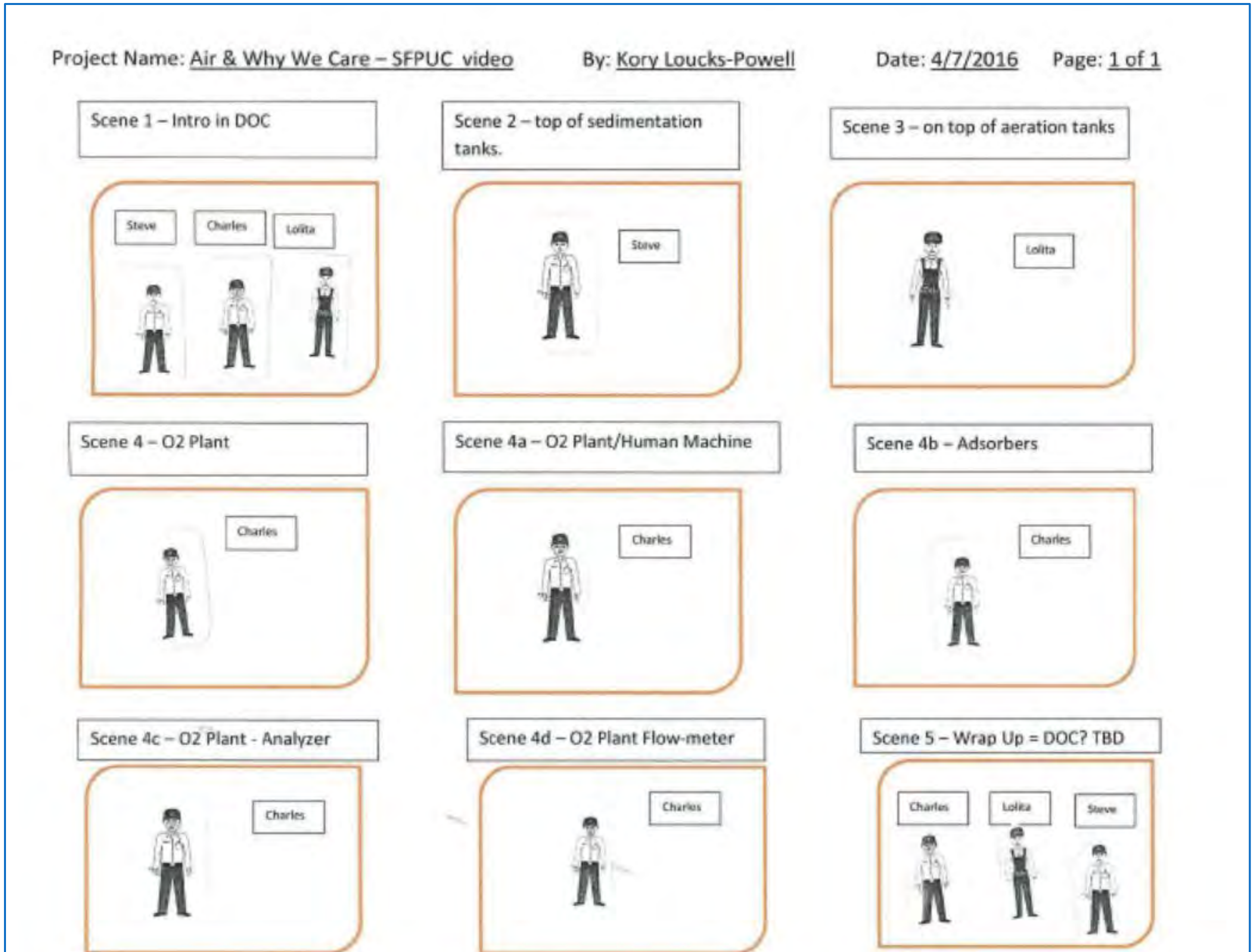
“The Air & Why We Should Care” SFPUC

Storyboard



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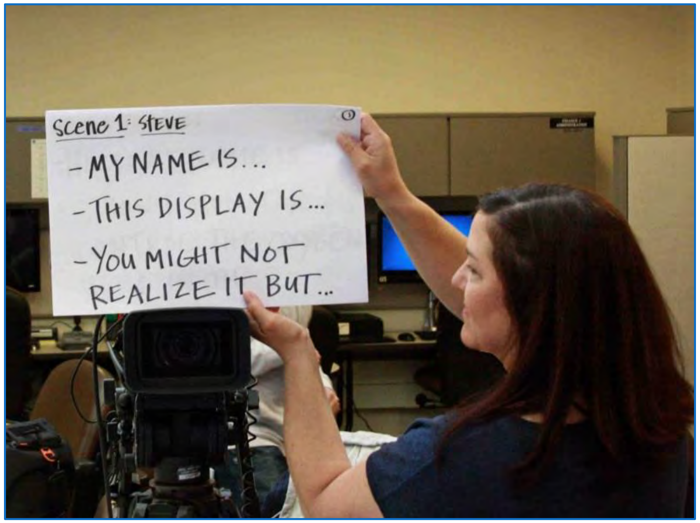
“The Air & Why We Should Care” SFPUC

(Video in Post-Production)



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“The Air & Why We Should Care” SFPUC

Candidate Development videos

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"The Air & Why We Should Care" SFPUC

Instructional Designer – Richard Moore, John O'Connell High School

- Who I am
- Why I wanted to participate
- Products

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Curriculum Deliverables

Coversheet for teachers

Air- Why We Should Care (Cover Sheet)

Introduction
The following lesson is meant to be used as an introduction to the study of gases. Learning is contextualized by workers at a wastewater treatment plant who, through video, discuss the role of oxygen in the treatment process, and how they generate, monitor, and control the oxygen. Lesson components have students investigate the composition of Earth's atmosphere, analyze how the atmosphere changes as pressure and temperature change, and engage in an hands-on investigation into how much oxygen is in air.
Intended Audience
The lesson is intended for a high school general chemistry class, or modified for use in an Integrated Science, or Earth Science course.
Prior Knowledge and Skills
To be successful with the lesson, students should be familiar with the Periodic Table, constructing and interpreting graphs, and the use of percentages.

Materials:
- Our Air- Why We Should Care (Do Now/JumpStart/pre-test)
- Composition of Air Handout
- How the Atmosphere Changes Handout
- How Much is Oxygen? Lab Activity Handout
- Checking for Understanding Exit Ticket
- Projector connected to internet

Estimated Timeframe: 100 minutes (2 50 minute periods)

Common Core Standards:
NGSS HS PS1-1 Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

NGSS HS PS1-5 Apply scientific principles and evidence to provide and explanation about the effect of changing temperature or concentration of the reacting particles on the rate at which a reaction occurs.

CCSS.MATH.HS.N-Q-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; choose and interpret the scale and the origin in graphs and data displays

Lesson Sequence
I. Do Now/Warm-up
II. Read Aloud Lesson Introduction
  a. Pair-share- "So, what do you know about air, and why should you care?"
  b. Share out selected responses or Whiparound
III. Read Aloud Composition of Air
  a. Review Composition of Air Data Table

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Curriculum Deliverables

Lab sheet for students

The Atmosphere- ***How Much is Oxygen?***

Date ________________ Period ______

Problem: When something burns it uses up oxygen. If you place a burning candle in a closed container of air, will it continue to burn?

Materials: Pie pan, ruler, candle, beaker (taller than the candle), match, water, pencil and paper.

Procedures:

1 Use melted wax to stand candle in the middle of a pie pan.
2 Carefully fill the pie pan with water to a depth of 3 cm.
3 Measure the height of the beaker.
   A) What is the height of the beaker? ______________
4 Carefully place the beaker upside down over the candle. The lip of the beaker must be completely underwater as it rests on the bottom of the pie pan.
5 Measure the height of the water in the beaker.
   B) What is the height of the water in the beaker? ___________
6 To calculate the amount of space in the beaker that is filled with water, divide the height of the water by the height of the beaker. Give your answer as a decimal to the nearest hundredth.
   C) What decimal did you get? ___________
7 To convert this decimal to a percent, multiply it by 100.
   D) What percent is this? ___________
8 Remove the beaker. DO NOT WET THE CANDLE.
9 Light the candle.
10 You will now trap a certain amount of air for the candle to burn. Carefully place the beaker over the candle. The lip of the beaker must be completely underwater as it rests on the bottom of the pie pan.
11 Observe your setup carefully.
   E) Does the candle continue to burn? _____________
   F) What happens to the water level inside of the beaker?

   G) How can you explain this?

12 Measure the height of water in the beaker.
   H) How high is the water? ________________
13 To calculate the amount of space in the beaker now filled with water, divide the height of the water by the height of the beaker. Give your answer as a decimal to the nearest hundredth.
   I) What decimal did you get? _______________
14 To convert this decimal to a percent, multiply it by 100.
   J) What percent is this? ____________________
   K) Based on your experiment, what percent of the air is oxygen? _____________
15 Compare your answer to question J with your answer to question D.

Experiments of this kind led scientists to the discovery of how much oxygen is in the atmosphere. The accepted value is 20.946 percent, by volume, of oxygen.

L) Calculate the % error between your value and the accepted value

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Warm-up for students

Our Air – Why We Should Care (warm-up)

On a separate sheet of paper, indicate whether you think each numbered statement below is true (T) or false (F), or whether you are unfamiliar (U) to judge. Then, for each statement that you marked as true, write a sentence describing a practical consequence, application, or example of how it is true. Reword each false statement to make it true.

___ 1. You could live nearly a month without food, and a few days without water, but you could survive only a few minutes without air.

___ 2. Air and other gases are weightless.

___ 3. The volume of a given sample of air (or any other gas) depends on its pressure and temperature.

___ 4. The atmosphere exerts nearly 15 pounds of force on each square inch of your body.

___ 5. Clean, unpolluted air is a pure substance.

___ 6. The main source of air pollution is industrial activity.

___ 7. The components of the atmosphere vary widely at different locations.

___ 8. Minor air components such as water vapor and carbon dioxide play major roles in the atmosphere.

___ 9. Oxygen is the molecule with the highest concentration in Earth's atmosphere.

___10. Pollution control has not improved overall air quality.

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Curriculum Deliverables

Worksheet for students

The Major Constituents of Air

A. Nitrogen - 78% - Dilutes oxygen and prevents rapid burning at the earth's surface. Living things need it to make proteins. Nitrogen cannot be used directly from the air. The Nitrogen Cycle is nature's way of supplying the needed nitrogen for living things.

B. Oxygen - 21% - Used by all living things. Essential for respiration. It is necessary for combustion or burning

C. Argon - 0.9% - Used in light bulbs.

D. Carbon Dioxide - 0.03% - Plants use it to make oxygen. Acts as a blanket and prevents the escape of heat into outer space. Scientists know that the burning of fossil fuels such as coal and oil is adding more carbon dioxide to the atmosphere.

E. Trace gases - gases found only in very small amounts. They include neon, helium, krypton, and xenon.

I. Using the information above, and a Periodic Table, answer the questions below about the composition of air.

1. List the top 4 components of air.

2. Based on the percentages listed above, what percent of air is composed of "trace elements"?

3. Complete the following table

Gas	Percent in Dry Air	Atomic Number	Atomic or Molecular Mass (g/mol)
Oxygen			
Nitrogen			
Carbon dioxide			
Hydrogen			
Argon			
Neon			
Helium			
Krypton			
Xenon			

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Curriculum Deliverables

Solution sheet for teachers

The Major Constituents of Air

A. Nitrogen - 78% - Dilutes oxygen and prevents rapid burning at the earth's surface. Living things need it to make proteins. Nitrogen cannot be used directly from the air. The Nitrogen Cycle is nature's way of supplying the needed nitrogen for living things.

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I. Using the information above , and a Periodic Table, answer the questions below about the composition of air.

1. List the top 4 components of air.

2. Based on the percentages listed above, what percent of air is composed of "trace elements"?

3. Complete the following table

Gas	Percent in Dry Air	Atomic Number	Atomic or Molecular Mass (g/mol) Rounded to 1 decimal place
Oxygen	20.9	8	16.0
Nitrogen	78.1	7	14.0
Carbon dioxide	0.035	X	44.0
Hydrogen (gas)	5.3×10^{-5}	1	2.0
Argon	0.93	18	40.0
Neon	0.0018	10	20.0
Helium	0.00052	2	4.0
Krypton	0.00011	36	83.8
Xenon	8.7×10^{-6}	54	131.3

Curriculum Deliverables

Vocabulary sheet for students

Vocabulary Rating Sheet Date ____________

Name ________________________

Rating Scale:
1 = I don't know it at all.
2 = I've seen it or heard it before.
3 = I think I know what it means but I could use a review.
4 = I know it well and can easily teach it to the class.

Word	Rating before instruction	What I think it Means **before** instruction	Correct Meaning	Rating **after** instruction
air				
temperature				
pressure				
concentration				
Fossil fuels				
Global warming				
Carbon dioxide				
essential				
altitude				
percentage				

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Curriculum Deliverables

Exit ticket for students

FRESH AIR

Exit Ticket

1. Is air a pure substance e or mixture of gases?
2. What gas has the highest concentration in air? What is it's percentage?
3. Our atmosphere is divided into how many layers?
4. State the relationship between altitude and air pressure.
5. Describe how the mass of an air sample changes with altitude

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Panel Discussion

Contextualized Learning Materials

Tue Rust, Math Director, Los Medanos College

- Contextualized Learning materials and how they can be used by teachers

Contextualized Learning Materials

Creating Relevant, Contextualized Curriculum

A Water Career Pathways & BAYWORK Project

WATER CAREER PATHWAYS

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bay area water/wastewater workforce reliability

Contextualized Learning Materials

Module Creation Process

Initial Meeting

- Leads from Baywork and Educational Institution outline a plan for the project
- Expand the group and flush out the plan
- *Cheryl, Tara, Cecil and Tue met and decided to focus on ETEC and math. Patricia, Ingrid and Diwa were then brought in and East Bay Mud became a focal point.*

Industry Profe-ssionals

- Determine initial industry professionals for a pilot
- Baywork contacts industry partners
- Partners agree to allow professionals to work on the pilot
- *Cecil suggested 3 students from EBMUD. Cheryl contacted Ted, who agreed to be the point person.*

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Contextualized Learning Materials

Create Module I

- Industry professionals and teachers outline a thought problem.
- Teachers create curriculum
- Industry professionals and Baywork create the video

Create Modeule II

- Baywork and teachers finalize the video and curriculum
- Module is formatted

Share

- Celebrational showing of the module

Contextualized Learning Materials

Creation of the Module

- **Titles**
  - Title I captures student attention
  - Title II informs teachers of skill focus
- **Hook**
  - 30-90 second video captures student attention and poses a thought problem
- **Curriculum**
  - Thought problem shared in text, with relevant graphics and data
  - Scaffolded curriculum that builds skill strength (1-3 hours)
  - Rigorous homework problem
- **Closing**
  - 30-90 second video sharing an interesting story relevant to the thought problem

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Contextualized Learning Materials

Organizational Chart

- Content Experts
- BayWork
- Community College
- High School
- Water Consortium Career Pathways

Contextualized Learning Materials

Timeline

Leads from Baywork and Educational Institution outline a plan for the project
Expand the group and flush out the plan
Determine initial industry professionals for a pilot
Baywork contacts industry partners
Partners agree to allow professionals to work on the pilot

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Contextualized Learning Materials

Timeline

Leads from Baywork and Educational Institution outline a plan for the project
Expand the group and flush out the plan
Determine initial industry professionals for a pilot
Baywork contacts industry partners
Partners agree to allow professionals to work on the pilot

Industry professionals and teachers outline a thought problem

Contextualized Learning Materials

Timeline

Leads from Baywork and Educational Institution outline a plan for the project
Expand the group and flush out the plan
Determine initial industry professionals for a pilot
Baywork contacts industry partners
Partners agree to allow professionals to work on the pilot

Industry professionals and teachers outline a thought problem

Teachers create curriculum
Industry professionals and Baywork create the video

Contextualized Learning Materials

Timeline

Leads from Baywork and Educational Institution outline a plan for the project Expand the group and flush out the plan Determine initial industry professionals for a pilot Baywork contacts industry partners Partners agree to allow professionals to work on the pilot
Industry professionals and teachers outline a thought problem
Teachers create curriculum Industry professionals and Baywork create the video
Baywork and teachers finalize the video and curriculum

Contextualized Learning Materials

Timeline

Leads from Baywork and Educational Institution outline a plan for the project
Expand the group and flush out the plan
Determine initial industry professionals for a pilot
Baywork contacts industry partners
Partners agree to allow professionals to work on the pilot

Industry professionals and teachers outline a thought problem

Teachers create curriculum
Industry professionals and Baywork create the video

Baywork and teachers finalize the video and curriculum

Module is formatted
Share Out

Contextualized Learning Materials

- Creating Relevant Contextualized Math Curriculum
- Next Steps

Next Steps: Concepts

What are concepts students struggle with, typically in pre-algebra or in algebra?

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Next Steps: Who to Involve?

What contributors and stakeholders are needed to create the capacity to fully engage the institution?

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Next Steps: Who to Involve?

Who will:

- Continue working on the problem?
- Focus on getting administrative and funding support?
- Be the team lead?

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Contextualized Learning Project

Renée Willette, BAYWORK
Candidate Development Co-Chair

Help Us Build the Program:

Your suggestions for future development, distribution, and utilization of Contextualized Learning curriculum

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