

Water Heroes Wanted!

Rising 4th and 5th Grade Students

Mrs. Sharon Hale

July, 2017



Water Quality through Filtration

Let us all show how we are the force to induce change and solve the challenges within communities locally and around the world!

We start by answering the call by Working Together as Change-Makers for Clean Drinking Water for ALL...

End this water crisis, one hero at a time...

Response Team Members are ready and able!



TABLE OF CONTENTS

I. INTRODUCTION

A. Rationale

B. Differentiation for Gifted Learners

II. GOALS AND OUTCOMES

III. ASSESSMENT PLAN

IV. LESSON PLANS 1 – 4

V. PERFORMANCE TASK

VI. UNIT RESOURCES





Water Heroes Wanted: Water Quality through Filtration

Concept: Change

Essential Understanding: Force Induces Change

The Essential Question: How Does Force Induce Change?

I. INTRODUCTION

Although Earth consists of 85 percent water, only one percent is fresh, drinkable water. Today, the students, or shall we say, the future students who will be environmental, chemical and civil engineers will need to fully understand the science and math pertaining to water quality, contaminants and filtration material in order to design filtration systems capable of providing potable water to the masses. It is estimated by the year 2050, four billion people may be living without enough clean water. Today, almost one billion people don't have clean water. In many parts of the world today, people, young and old have to travel by foot to find water sources. This

hunt for water is a four-hour daily journey, about as long as each instructional lesson will take in this unit. These treks prevent family members from attending school and they face arduous conditions before, during and after the trek. The water sources in which many rely upon in countries have been compromised in such ways that many are affected by diseases immediately upon consumption ending their day in a medical facility because the water is not clean and there is no filtration process and or knowledge about filtration processes.

What is one to do? Water is essential for life. That is why students need to learn more about water.

A. Rationale: “The Project Approach provides endless opportunities for challenges, because each project is only restricted by the investigators’ own questions and resources.” That statement from Jean Piaget summarizes the problems and dilemmas in 21st century learning. Just where can – or should – the mastery of facts begin and application of knowledge meets the potential in every unique learner? In this four-day, four hours a day summer enrichment camp unit called “Water Heroes Wanted,” Academically Intellectually Gifted (AIG) students will jump start their understanding by mastering the facts and proceed toward becoming an expert on the topic, Water Quality through Filtration. These students are guided by their critical thinking. As the educator understands how the children's ideas about the content develops, connections are made between their ideas and important ideas within the discipline.

The “doing approach”, active learning, grants students immediate awareness of how hands on inquiry-based learning leads to informative investigation to conceptually tackle and solve problems about clean water for all, not just some. The questioning in this unit is higher level and open ended. Great questioning forces students out of their comfort zone to think of things they never would have imagined.

This is evident when students think like an engineer to solve the storm filter theft in lesson three. In that scenario, students have to think in multiple factors. Water filters have been stolen and they need to find a way to replace them. They learn if the water is not filtered, it will change the clean drinking water they enjoy at home. A real-life situation is now in the content, process and concept mode. And, oh yes, the AIG students solve this problem with limited resources offered from the water departments and just before an expected storm hits the region.

The pace and delivery is dynamic and value added through unique choices of content, process, products and learning environments. It would be unacceptable to think this unit is neat and tidy. It will require a major clean-up crew upon its conclusion. Students get their hands dirty, literally working with dirt and all types and nontoxic debris.

It is not until the last lesson where they go from laboratory to laboratory and test and understand what scientists are doing in each lab, they are able to understand how each lab is connected to each other – kind of like a complex pattern puzzle. Each lab is different as each one is showing how force is inducing change in water quality.

AIG students are allowed to indicate, expand, formulate, imagine, plan and form new understanding about clean water methods and the importance of clean water because of the depth of content, processes and knowledge they will experience with a Project Approach in all four lessons designed. The students understand and use the discipline as a means of looking at and making sense of the world.

The overall expectations are for the gifted learners to come away with more than how to clean water through filtration, but how a filtration system could change lives for all. Students watch visual stimuli, listen to primary resources about their lack of clean water, carefully view authentic pictures of why it is not a balance in the world when it comes to clean drinking water for all. The AIG students are also exposed to picture books and written stories which support this reality.

B. Differentiation for Gifted Learners: Students create a water filter to change water quality in lesson one and by lesson three they advance their knowledge and as a result are required to build a clean water filter system to change water quality for their community. AIG students are capable of absorbing an extraordinary quantity of information and have excellent memories so in each progressive inquiry based hands-on approach, the students continue to acquire new understanding about Water Quality through Filtration and continue their quest toward how force induces change. As a final project, students become clean water advocates and design an informational message from their experiences and content knowledge based on the four-day enrichment camp.

All the lessons and performance tasks make it appropriate and beneficial for gifted learners. As Van Tassel-Baska said for gifted learners in language arts, but is also valid for science and engineering, “Problem-based learning by the sheer demands of working on ill-structured problems poses a particularly appropriate instructional approach for gifted program use. Thus, strategy differentiation involves a set of techniques that need to be matched to advanced curriculum in order to be effective for advancing the learning of gifted students.”

Lesson one is a perfect example where ill-structured problems are presented from a creative model and this sets the path for risk taking.

There is a clear objective from the beginning that high expectations are expected. Curiosity builds off the main ideas of understanding the concept of change, but then creativity takes over. Students work with intensity and persistence at their own pace with an end goal in mind. Students creating water filters are the force that induces change in water quality. They get materials and no set of directions. Change is in the eye of the beholder. They are reflecting on their skills and interests as they relate to the discipline.

There is an established purpose of measurements of success as students are able share their struggles and accomplishments based on their efforts. With each design tweak, students will be

able to show their successful efforts. Their designs end up justified as water changes from murky to clear.

Students can make decisions based on open-ended, higher level questions posed to them during and post lesson time. The learning environment is very open where students can create however they want – from working alone to working in a group or consulting with the educator. They choose from a wide variety of materials and, like a race horse, they are off. Through their curiosity, creativity, eagerness to learn and diligence, they patiently strive to construct prototypes to achieve their goals.

The complexity and challenge stems from questions while examining how people all over the world hunt for water. Students are asked to place themselves in the shoes of the people hunting for water and think deeply about what it would be like to be them on a daily trek. This is where they project themselves into the discipline. Using interactive technology and having technology available to research the information needed to morph into the child who hangs onto their mother or older sister while trying to cross a contaminated river of water which is about to become their water source for the day, is incredibly powerful.

Depth of thinking will take place as students discuss their devices that force change. What is essential understanding for 21st century learning is happening in this lesson. The just in time content is presented and available. Although the filter materials are common in most environments, thinking outside the box, they were able to use them in different ways and in different order. That allowed for a complexity and rigor in the design process. The educator is coaching students rather than telling them how to make the filter. Answers lie in the questioning. The discussions induce deep thought processes and pave the path for a creative and risk free environment. This environment is beneficial to AIG students because it challenges their intellectual and social emotional needs, which boosts their learning potential. This lesson is significant to evaluate if their abilities are just below the challenges in order to avoid student frustration.

For all of these lessons, a long attention span is required. In essence, the learner is provided the platform to force change and perseverance prevails in order to solve the problem. The overarching concept of change is they are the change makers. The AIG students are forcing change for those who need clean water.

The curriculum of connections in lesson two provides students a formal platform to synthesize and evaluate text. AIG students closely read about how multiple forces induced change for citizens who rely on a river system for clean water. The river system is suddenly shut off to the citizens and clean drinking water is not available. In this lesson, AIG students are introduced to the Socratic Seminar. They are asked to think deeply about higher level content and then come up with higher level questions about the content as they dialog about this real world event. For

gifted students, advanced cognitive and affective capacity for conceptualizing societal problems will help students reach their leadership abilities.

Lesson two embraces an intellectual discussion which reinforces the concept of change. This seminar enables students to step into the shoes of those who are not able to use a water source because of decisions made by the Chief Executive Officer (CEO) and other officials of a chemical company. Students dialog about the emotional and social changes and the living and nonliving forces which induced the changes through the lens of a water consumer. They will think and apply key concepts, principals and skills to a range of instances throughout the discipline, and be able to transfer the discipline across location and perspectives. Through the eyes of various people who were forced to change their lives because of the real world event, students will examine links between concepts and development of the disciplines.

Students delve into the internal and external ramifications of the chemical spill into the drinking water source. For gifted students, advanced levels of moral judgment and moral sensitivity allow them to embrace their affective and social emotional characteristics.

For AIG students, the unusual quantity of input from the environment through heightened senses of awareness provokes their psychomotor characteristics.

This lesson puts the students in an environment where they see changes in a negative and positive way. By employing a Socratic Seminar to discuss the numerous changes in people's lives, it will force students to recognize force does in fact induce change. AIG students will thrive because they are allowed to ask why and what if questions confidently through interactive dialog and respect of opinion and factual information. There will be a high degree of energy to help students meet their potential because everyone has a voice.

II. GOALS AND OUTCOMES

Goals and Objectives

Listed are the goals and objectives for this unit. The goals and objectives are categorized by content, process and concept. The goals and objectives are founded on the Next Generation Science Standards State by State Standards and the Integrated STEM Curriculum aligned with North Carolina, National and Industry Standards.

Content Goals and Objectives

Goal 1: To develop a basic understanding of engineering design which is founded on: Ask questions, imagine the outcome, plan for outcome, create and improve.

Students will be able to explain multiple-solution approaches to problems with extraneous information as they:

A. Analyze basic science mathematic and engineering principles to understand the

- problem and find solutions to meet objectives.
- B. Incorporate a set of strategies for finding solutions to questions on how unclean water becomes clean water by filtration.
 - C. Describe design methods including the analysis behind construction and testing of filtering systems to force change in water quality.
 - D. Compare and contrast the importance of construction and material choices in filters in order force change in water quality.

Goal 2: Understand the role of filtration within environments.

Students will be able to apply the engineering design process in a design challenge as they:

- A. Examine evidence gained through observation and investigation to describe next steps for expected solutions to induce change in water quality.
- B. Develop a sense for natural and unnatural patterns to scientific discovery.
- C. Exemplify alternative methods of design to further force changes in water quality.
- D. Evaluate alternative viewpoints in engineering designs for modification and sustainability purposes.

Process Goals and Objectives

Goal 3: To develop communication skills with application to science and engineering principals to solve problems.

Students will be able to implement the engineering design process in oral communication as they:

- A. Brainstorm ideas and make preplanned goals in real time.
- B. Come to a consensus and work in collaborative groups to arrive at solving problems in a systematic process.
- C. Make decisions based on critical thinking skills using prior knowledge and new information and language of the discipline.
- D. Share evidence and present findings to others as feedback is elicited.

Goal 4: Develop reasoning skills with application to science and engineering principals to solve problems.

Students will be able to implement the engineering design process in written communication as they:

- A. Visually represent a design as a piece of functional art by drawing and labeling the model as a scientific diagram/drawing.
- B. Make inference statements based on evidence and write statements as general and concluding statements.
- C. Illustrate examples and relevant information throughout the design process as a historical reference.
- D. Write about the calculated risks, note subtleties and data to support decisions which influenced criteria.

Concept Goals and Objectives

Goal 5: Understand the concept of change.

Students will be able to embrace scientific and engineering habits of mind (Making 'things' that work and making 'things' work better) as they:

- A. Use their system thinking, teamwork, optimism, communication and creativity to

force change in society's problems.

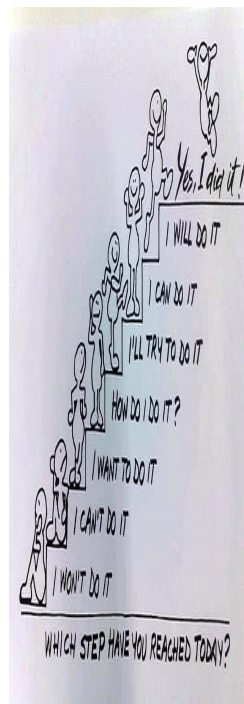
- B. Recognize the roles and responsibilities of change makers as clean water experts.
- C. Learn from clean water experts as to ask continuous questions about change.
- D. Transfer attention to ethical considerations about change as new forces at home and abroad present themselves.

Goal 6: Lead as examples of change.

Students will be able to meet their potential as they:

- A. Assess how forces induce change as a motivation for clean water.
- B. Think critically about the simple and complexities of change such as how change overlaps with other changes, nestles itself inside other changes is time sensitive, and multi-faceted.
- C. Celebrate accomplishments about efforts which force change in society to ensure positive outcomes and view negative outcomes as a learning tool for problem solving.
- D. Encourage others to view themselves as water heroes advocates.

III. ASSESSMENT PLAN

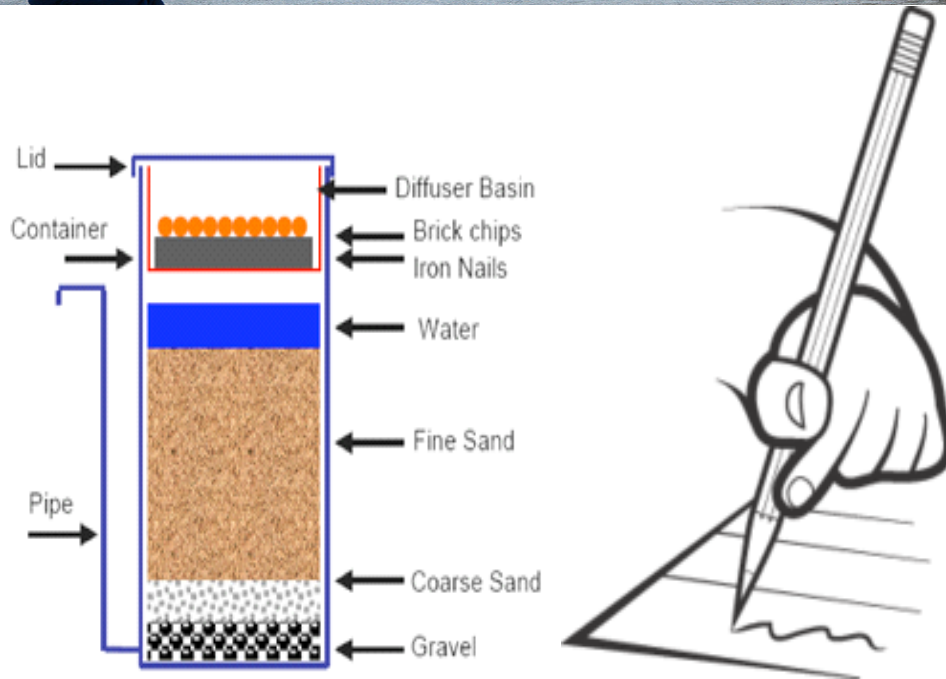


At what moment did you understand the concept of

change?



How do you understand how force induces change?



The goals of the assessment plans are to evaluate ranges of achievement at different moments in time and provide necessary student feedback on their strengths and areas of a growth mindset. As assessments are based on the growth mindset model, students will be able to understand the content, processes and concept on deeper levels at their own pace.

In this unit, informal, formal and summative assessments are used to provide evidence students understand unit goals and objectives. A variety of rubrics are inserted at specific times within the body of each lesson to place emphasis on clarity of defined criteria in specific terms.

Assessments in this unit put a strong emphasis on aspects of the discovery. The assessments enable students to discover new knowledge and understanding which meet their potential on the learning continuum. The assessments focus on the behaviors and processes of students as well because students are asked to explore materials, consider possibilities and solve problems.

As the unit lessons continue to show a strong student-centered flexible and accepting environment, assessments play a significant role as to whether students are willing to take risks.

The engineering and scientific content, processes and products depend on fostering risk taking therefore evaluative measures are about high expectations to be embraced, not feared. The educator and student are in constant dialog promoting understandings about how force induces change at different moments in time and provide necessary peer to peer student feedback to be more consistent and objective.

There is no formal multiple choice test in this unit to demonstrate their achievements based on each standard. All the assessments are reflections and designs in action. The assessments are to be a culmination of knowledge through application.

Students will show they understand the concept and essential understanding when their ideas, experiences and reflections are illustrated and presented to a board of clean water educators in printed form. This summative performance task will need to include all the knowledge they obtain to send a message to the world that clean water is important for all, not some. It will also show how force induces change when they create filters to convert dirty water to clean water. It is also based on choice. The students will be given choices as to how they want to demonstrate what they know for their poster design which incorporates the importance of clean water methods and what they learned.

As student discussions, problem solving work, and written reflective thinking individually forms, it becomes easier to observe their behaviors and thought processes. Because this is a critical aspect of real-world application, the unit is non-competitive, where it is designed where the whole team wins. This atmosphere lends the assessment process to meet a natural fit for students who want to grow, have the potential to grow and learn. It invites every student to a table of understanding. Keeping this spirit of collaborative information gathering, reflective independent moments are also important in the assessment process. The assessment part of the lesson is a combination of oral, written and illustrated evaluations. These assessments should open the lines of communication and provide feedback to keep the forward momentum of understanding continuous.

Pre-Assessment

For the first assessment, students will identify whether they possess the critical definitions that define the entire unit. They will answer questions about filters, devices, prototypes, water importance, global water crisis and water systems and general knowledge about the scientific questioning and engineering process (See sticky notes by group on whiteboard below).



Daily Formal Assessments: Science Journal Entries called Reflections

Science Journal entry key elements for student reflections:

- Students receive immediate feedback from educator based on their discoveries, investigations, understanding and questioning.
- Students are provided a reflection moment to think about their learning, analyze their findings and express their thoughts.
- Students are able to dialog with the educator based on evaluation criterion and offer explanations of understanding in various ways.
- Students practice how to record their daily observations in sequence as real world scientists and engineers do by topic and subject. These running records are reference points for opportunities to extend critical deep thinking.
- Students are able to share knowledge with guardians and parents for home to school feedback all year long.

- Students are able to make cross curriculum connections to topics and concepts based on ongoing reflections and feedback.
- Science Journals inform instruction for the educator and the student.
- Science Journals establish a range of scores based on understanding.

Water Hero Wanted! “Today I learned...” Science Journal Entry Reflections



Water Heroes Wanted!

How does force induce change?

Reflection Entry can be written and drawn and must be explained.



Date _____ Time _____

Student Sections

Reflective Entry:

Today’s lesson was all about... and I learned...

Illustration/scientific drawing

Educator feedback:

Possible achievement score: 4 -- Student reflects about topic and asks questions showing a clear understanding of the concept at all times. Today's score is: ____

Possible achievement score: 3 -- Student reflects about topic and asks questions showing a clear understanding of concept most of the time. Today's score is: ____

Possible achievement score: 2 -- Student needs new opportunities/strategies to show a clear understanding. Today's score is: ____

Educator written feedback section: Thoughts about the engineering, science and other understanding today. _____,(student name) understands concept of the day because _____

Student engineer and scientist response about today's understanding and response based on educator feedback: Where do you see your growth in understanding the concept today?

Student engineer and scientist response about today's knowledge.

I still wonder about:

- Remember to bring this question to our discussion tomorrow! We want to hear from you!



Water Filter Rubric Lesson One and Three

Name: _____ Date: _____ Class: _____

Water Filtration Project Rubric

	Beginning	Developing	Proficient	Advanced	Total
Attentiveness (25%)	Was uncooperative; was disrespectful of others 10 points	Was quiet when others spoke 15 points	Participated actively in discussion; asked questions 20 points	Participated actively in discussion; was respectful ; asked relevant questions 25 points	
Researching (25%)	Did not participate 10 points	Used resources 15 points	Used appropriate resources 20 points	Worked well with others; offered several suggestions explaining rational; used appropriate resources correctly 25 points	
Teamwork (15%)	Was uncooperative; was disrespectful of others 7 points	Contributed a little; was quiet when others spoke 12 points	Participated actively in discussion; was considerate of others' contribution 14 points	Worked well with others; participated actively in discussion; was respectful and encouraging 15 points	
Planning (10%)	Did not participate 5 points	Offered one idea 8 points	Offered more than one suggestion 9 points	Worked well with others; offered several suggestions explaining rational 10 points	
Filtration System (25%)	Water does not appear any different 10 points	Some particulates were removed, but water is still dirty (suitable for plants) 15 points	Many particulates were removed (suitable for animals) 20 points	Water is visibly cleaner; most particulates were removed (suitable for humans) <i>Do NOT drink the water!</i> 25 points	
TOTAL →				Maximum = 100 points	

Summative Assessment: Performance Task Rubric

Suggested Poster Design Layout

Title		
Group member names, grade and year		
Background (What do you know about the project?)	Method (How did you do what you did?)	Conclusion (What did you learn?)
Objective (Why did you build what you built?)	Results (What happened when you tried it?)	Future Work (What else can we do to learn more and make improvements?)



IV. LESSON PLANS 1 – 4

TEACHER NAME		Lesson #
Mrs. Sharon Hale		1
MODEL	CONTENT AREA	GRADE LEVEL
Creative Problem Solving	Science	3-5
CONCEPTUAL LENS		LESSON TOPIC
Change		Water Filters
LEARNING OBJECTIVES <i>(from State/Local Curriculum)</i>		
3. V.3 Create art using a variety of tools, media, and processes, safely and appropriately. 3.CX.2.2 Understand how to use information learned in other disciplines, such as math, science, language arts, social studies, and other arts in visual arts. 3.CX.2.3 Use appropriate collaborative skills to create a work of art. NCES. 3.L1-3.L3 Understand all human body systems require basic requirements to function. NCES. 4. L.2.1. Classify substances as non-food items based on their ability to provide energy for survival, growth and repair of the body. NCES. 5.L.1.2 Compare the major systems of the human body in terms of their functions necessary for life. NC Essential Social Studies Standards Third-Fifth grades - Students deepen their understanding of human-environment interactions by assessing positive and negative effects of human activities on the physical environment. Students draw upon knowledge learned in previous grades to develop more sophisticated understandings of how communities may be linked to form larger political units, and how there are cultural, geographic, and economic connections. Through their study of various patterns of community living, the students begin to understand that people's activities are influenced not only by their geographic location, but also by how they use the earth's materials, the physical environment, and how they express their diversity through culture.		
THE ESSENTIAL UNDERSTANDING <i>(What is the overarching idea students will understand as a result of this lesson?)</i>		THE ESSENTIAL QUESTION <i>(What question will be asked to lead students to "uncover" the Essential Understanding)</i>
<i>Force induces change.</i>		<i>How does force induce change?</i>
CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)		PROCESS SKILLS (What will students be able to do as a result of this lesson?)

Students will learn: • Advancements are in response to human survival needs and technological prototypes. • Creativity is the spark that allows for risk taking. Generating ideas in innovative practices and inventions can force change and save lives. • Forcing change requires open discussions and brainstorming of ideas in a sequential process for creative innovation to occur. • Being change agents forces people to solve problems in order to meet basic needs and wants. • Force induces change because improvements are necessary to advance human conditions. • Materials and the availability of materials dictate change and forces time frames and induces additional thinking to meet the challenges that exist in the world. • Environmental awareness is examined in creative design. • Change requires examining choices from designer perspectives. • Key terms and phrases.	Students will be able to: • Engineer and create devices based on collected criteria and visual and researched information. • Arrive at construction stages asked on available materials and current information in real time. • Come to consensus and work in collaborative groups. • Make decisions based on critical thinking skills using prior knowledge and new information. • Take calculated risks. • Visually represent a design as a piece of functional art through a model and a scientific diagram/drawing.
--	---

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
------------------------------	---------------------------------	-------------------------------

• What are the people in the photographs forced to do? • What reasons induce this force? • What changes are possible to make water quality different? • How would your life change if you were forced to drink water that was not safe? • Why is water important in your daily life? • What device could force change in the water quality? • What is a filter? • Where are filters? • What are some objects that have filters? • Why do you believe your filtering devices will force change for people? • When is change positive? When is change negative? • What is a prototype? • What type of water filter would you want to construct to help these people force changes for a healthier life immediately?	• How do you choose the optimum materials to force the most significant changes in water quality? • How does water change? • Why a filter is considered a force? • What design features forced clean water? • How did you change the design for efficiency? • What challenges have you encountered as you are designing your water filter that forced you to change your direction to meet your goals? • How do you believe water will change as a result of your redesign(s)? • Why is the design changing? • What forced you to think the changes you made in your prototype would force water to filter? • Why are some materials in the water filter forcing particles to change? • How does a student build a water filter for slow or fast changes? • Why did your group decide on these materials for your final water filter design? • When you test your water filters, describe the methods that will	• Invent a new advocacy message based on your creative design. • What type of challenges did you and your team members overcome based on your need to creatively solve the water problem? • If you had additional resources, time and unlimited funds, what would you do to the design to improve the efficiency and construction? • In the collaboration processes, what quality design decisions were you willing to come to a consensus about and why? • How did your creativity foster innovation? • If you had to rank water quality for all as a priority in the world, what rank would this topic be and why? • Why would creating water would filters force change for all? • Imagine you were presenting your model to a group of change agents, what do you believe might force them to think differently about placing your prototype in the hands of every person in the world who does not have access to clean water?
---	---	--

	force the water to change under “normal” conditions, variable conditions. • How did you choose the optimum materials to force the most significant changes in water quality? • What water filter would be considered a prototype for people in these photographs to force change in their lives? • What if you could not afford a manufactured water filter, what materials could be changed to help you build one and how would you know the filter you built provides filtered water? • Of the top three needs of survival, where would you rank water to force change? • What would be your justification for your selections/rankings?	
--	---	--

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.)

Content	Process	Product	Learning Environment
	Inquiry based problem solving and creative risk free instructional models promote critical thinking and ideas students are able to build their desired pathways of perseverance leadership and collaborative efforts to meet goals they have established.		Limited structure peer to peer interactions with discussion, questioning and technological observations.

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

- Students enter the classroom and will notice four designated stations marked one through four.
- Each station has a computer screen displaying a revolving slide show of people all over the world gathering water in jugs and containers from dirty, polluted and unsafe conditions. *
- There is “concerning” soft music playing in the background to set the scene of importance and suspense.*
- The teacher is silent, however, as students file into their assigned seats, next to a table with a variety of non-transparent sealed containers there is a massive sign that reads: “Do not open until gloves are worn and only for use of creative engineers.
- The music stops and the teacher (educator) announces: “Please find your spot; you have been called to action. A name tag is carefully wrapped around the neck of an unopened 16.0 FL OZ (500mL) bottle of clean drinking water.
Taped to the water bottle is a prepared three-circle Venn diagram.

Students are advised to:

- Carefully search for their name tag
- Greet their teammates

Ice-Breaker: Students are encouraged to talk in their group about themselves and why they believe they are alike as water heroes. After a brief discussion, the students must decide on two ways in which they are alike. With sharpies, they write the responses in the intersecting areas of the diagram. Then each student must write in his or her circle two facts unique to him or her as water heroes. Students also:

- Notice the assigned station number where they will start and finish
- Read the name tag to every member of the team - Engineer Name, (student name), Title: Water Filter Expert, and Response Team Member
- Place your official name tag on!
- Remember to bring your clean bottle of drinking water wherever you go

While at each station, students will be asked to answer a set of questions posted on a question anchor chart. Using their sticky index cards located in station, they respond to the questions and stick them to the answer anchor chart.

Pre-Lesson Questions

- What are the people in the photographs forced to do?
- What reasons induce this force?
- What changes are possible to make water quality different?
- How would your life change if you were forced to drink water that was not safe?
- Why is water important in your daily life?
- What device could force change in the water quality?
- What is a filter?
- Where are filters?
- What are some objects that have filters?

- Why do you believe your filtering devices will force change for people?
- When is change positive? When is change negative?
- What is a prototype?
- What type of water filter would you want to construct to help these people force changes for a healthier life immediately?

Students then gather together after each team rotates to all four area stations to discuss the visual impact of the slide show pictures and include in the discussion key points based on pre-lesson questions to move forward to the explore phases of the lesson.

- How will creativity help the people in the areas with their water problems?
- What types of sketches would it require to formulate your ideas?
- How is your creativity and innovation forcing change?

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

The moment then arrives when the containers are opened and the students gather around them to view the contents as they are placing gloves on their hands and a discussion about contamination takes place.

Included in the containers are:

Gallon jugs filled with contaminated water similar to that from the areas viewed on the slide show. Each jug is marked by numbers 1-4 so the water is varied depending on the type of water source.

Mess Finding:

The educator chooses a team member from each station to describe what they believe the materials are.

(there are: 2 liter plastic empty transparent soda bottles with a variety of caps, charcoal from camp fires and the charcoal is in chunks and pieces, cotton balls and cotton squares, elastic bands of all sizes, paper towels and napkins, pebbles of all textures and sizes from very small in diameter to the size of a student's thumb nail, sand, fine and coarse with sea shells that are crushed to the touch, all types of lengths of grasses, the grass has been cut from lawns or fields that grow wild flowers and different types of weeds, hay, pine straw, rocks the size of a golf ball and all shapes and colors, and pieces of string and hole punchers and sharpie markers and rulers that have standard and metric measurements, vines from trees and tree bark that resembles mulch. There are supply bags that contain graph paper with one centimeter paper and small sketch pads and pencils with erasers, scissors, clear drinking cups and magnifying glasses.) There is one digital camera that each group will use once their water filter is to be presented.

The teacher provides students with the challenge to create a water filter from the materials described by the student presenters. In addition, the teacher hands one member of each team a fact sheet containing additional information about the location in question.*

Fact Finding :

Students are now prepared to view all the materials, but cannot touch them yet. They are instructed to meet as a team and determine who will gather the materials after they discuss what the materials they believe they will need. They will state their objectives and elect roles and responsibilities such as: Presenters, scientific diagram artists, discussion and note taker, and other roles they are able to determine necessary in the creative process. At this phase, students are reminded collaboration will move the process forward. The rules of consensus are reviewed. They learn you may not agree with a decision, however, you can live with it for the benefit of the objectives established by the group.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Problem Finding:

The engineers will design and plan how they will build their water filter. They will need to communicate with one another the goals and objectives they need to accomplish. Included in those goals and objectives is the testing process. This is where they will write details and follow them as scientists.

Idea Finding:

The teams are given the opportunity to present their sketches and their designs to other design groups prior to gathering the materials and planning for the actual discussion. This is the stage where they receive feedback and constructive suggestions from fellow classmates. It is also not seen as a competition, but one of how the real world depends on economies of scale. This mind sharing provides even greater opportunities for effective and efficient results, especially as the human conditions are depending on innovative and creative ways to solve world issues. When a series of questions from other collaborative groups arrive, the educator assigns the engineer in the groups to note the suggestions they used and then talk about the results once their design is tested. This is an important phase because there is no room for judgment, but rather brainstorming will stimulate and foster innovation.

The educator is facilitating and acting as an assessor using these moments to provide guidance only if students are stalled, or the opposite, have bleeding edge questions.

Solution Finding:

Students are creatively thinking and deciding the best approaches for building the water filter they will eventually test to see if it works.

Evaluate: *This phase assesses learning and teaching and can use a wide variety of informal and formal assessment strategies.*

As students review their roles and responsibilities, they are now ready to put their work plan to action. For the next 40 minutes, students are in the roles of creative thinkers who have planned and have a purpose greater than their own.

Each task is posed as an opportunity to create a water filter that will meet the needs of those they observed in the slide show. The materials are gathered by one supply person on the team. As supplies mentioned in the Mess Finding are sought after, some of them may have disappeared

because other teams may have taken them for their designs. Therefore, plans should be fluid and flexible and students' creativity is even further stimulated as they solve and critically think about how to handle materials no longer available. The same supply person listens to other team members on what they need for a redesign or other ideas. The teacher is constantly circulating to ensure all students have equal access to learning. The students are also given an evaluation sheet to not only let others in their group know the contributions they met in the eyes of a teammate, but also get the chance to work with evaluating themselves. An assessment rubric is established for each student to follow in the creative process, but not as a deterrent, rather a motivating document.

Questions are posed during this phase.

During Lesson Questions:

- How do you choose the optimum materials to force the most significant changes in water quality?
- How does water change?
- Why a filter is considered a force?
- What design features forced clean water?
- How did you change the design for efficiency?
- What challenges have you encountered as you are designing your water filter that forced you to change your direction to meet your goals?
- How do you believe water will change as a result of your redesign(s)?
- Why is the design changing?
- What forced you to think the changes you made in your prototype would force water to filter?
- Why are some materials in the water filter forcing particles to change?
- How does a student build a water filter for slow or fast changes?
- Why did your group decide on these materials for your final water filter design?
- When you test your water filters, describe the methods that will force the water to change under "normal" conditions, variable conditions.
- How did you choose the optimum materials to force the most significant changes in water quality?
- What water filter would be considered a prototype for people in these photographs to force change in their lives?
- What if you could not afford a manufactured water filter, what materials could be changed to help you build one and how would you know the filter you built provides filtered water?
- Of the top three needs of survival, where would you rank water to force change?

After 40 minutes of building time, the educator takes a survey of the groups that will require additional time. This survey will place an emphasis on how designs have changed, or not changed, by requesting students to provide a series of redesign sketches with explanations. The students will know the importance of the creative process as they continue to review the illustrations, notes and finally the presentations to other design groups.

Each redesign is noted by time stamps on their journal entries and finally the time is cut off and presentations are prepared for demonstrations using the final design.

The discussion is question and answer responses from the post questions:

- What type of challenges did you and your team members overcome based on your need to creatively solve the water problem?
- If you had additional resources, time and unlimited funds, what would you do to the design to improve the efficiency and construction?
- In the collaboration processes, what quality design decisions were you willing to come to a consensus about and why?
- How did your creativity foster innovation?
- If you had to rank water quality for all as a priority in the world, what rank would this topic be and why?
- Why would create water filters force change for all?
- Imagine you were presenting your model to a group of change agents, what do you believe might force them to think differently about placing your prototype in the hands of every person in the world who does not have access to clean water?

Photos are taken of all the designs and the team members.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Formal assessments: Students evaluate their team members achievements during a formal discussion group. In their science journal students write and response to the following prompts:

Prompt One

What I admired about _____ as he/she forced changes in the design.

1. _____ -
2. _____
3. _____

Prompt Two

Force induces change because I learned

1. _____ -
2. _____
3. _____

Students are able to include all of scientific diagrams and reasoning for redesigns which indicated how force induces change.



Presentation Talking Points

Information Sharing

Group Engineers and Scientists Members are:

- 1.
- 2.
- 3.
- 4.
- 5.

End Results: Water Clarity (circle one)

- Very dirty
- Somewhat dirty
- Slightly dirty mostly
- Clean very clean

Time to filter (in minutes): _____

Number of tests to filter: _____

Water volume (ml) _____

Conclusion:

(Include **Problem Finding information while presenting your findings:**

How water filters were changed.

How goals and objectives forced change.

Include any changes in the testing process.

Share what forces induced changes.

TEACHER NAME		Lesson #
Sharon Hale		3
MODEL	CONTENT AREA	GRADE LEVEL
Socratic Seminar	Language Arts/Science	4-5
CONCEPTUAL LENS4		LESSON TOPIC
Change		Contaminated Water, Uncharted Chemical Infiltration
LEARNING OBJECTIVES <i>(from State/Local Curriculum)</i>		
RI.4.3 Explain events, procedure, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information. Next Generation Science Standards The NGSS content is focused on preparing students for college and careers. The NGSS are aligned, by grade level and cognitive demand with the English Language Arts and Mathematics Common Core State Standards. This allows an opportunity both for science to be a part of a child’s comprehensive education as well as ensuring an aligned sequence of learning in all content areas. The three sets of standards overlap and are reinforcing in meaningful and substantive ways.		
THE ESSENTIAL UNDERSTANDING <i>(What is the overarching idea students will understand as a result of this lesson?)</i>		THE ESSENTIAL QUESTION <i>(What question will be asked to lead students to “uncover” the Essential Understanding)</i>
<i>Force induces change.</i>		<i>How does force induce change?</i>
CONTENT KNOWLEDGE (What is the overarching idea students will understand as a result of this lesson?)		PROCESS SKILLS (What will students be able to do as a result of this lesson?)

Students will understand: • Chemical spills change water quality. • Human decisions made by some can force change for all. • Clean water is altered by human force. • Water safety standards are regulated by a set of standards governed by the Environmental Protection Agency (EPA). • There is a governmental arm of protection for the environment called the EPA. • The , EPA forces change to protect environmental conditions. • Access to clean water is critical, life changing. • A chemical plant incident can force change to water sources. • Chemical exposure forces human body reactions and changes the way people view water conditions. • Uncharted chemicals force new clean water standards. • Safety standards induce societal and scientific change for future generations. • Changes can force human emotions and induce questions. • Identify and be able to transfer general interpretations to specific human and process changes. • Human experiences can force change positively and negatively.	Students will be able to: • Develop moral reasoning. • Select key terms, concepts and share ideas openly. • Judge essential and incidental evidence and realize it is not about the right answers, but in search for evidence in the text to support their ideas. • Predict future outcomes based on evidence from informational text. • Recognize patterns and real-world relationships. • Converse with peers by responding to open ended questions. • Create questions. • Collaborate with peers. • Think critically about water quality. • Observe and listen with intension. • Establish a voice. • Develop scientific inquiry based questioning because of context. • Analyze multiple perspectives. • Investigate questions to widen topic knowledge. • Draw conclusions. • Make inferences. • Identify and be able to transfer general interpretations to specific human and process changes. • Make inferences, conclusions from real-world events.	
GUIDING QUESTIONS <i>What questions will be asked to support instruction?</i> <i>Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding</i>		
Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:

Where is West Virginia? Why is clean drinking water so important? Where do homes get their drinking water from? How does water change from a river to the clean water you get in your home? What happens to the river water when chemical storage tanks start leaking? We all know water flows downstream, how could you prevent bad water from reaching a home?	What forced the change in water quality for the residents in West Virginia? What forced the changes for the people living in West Virginia in January, 2014? How might these events force change for the population in West Virginia and for everyone on this planet? Why did changes occur for the residents in West Virginia? How did the chemical spill change the area in which it occurred? Why would businesses be forced to change because of the changes in people's lives? What were the long term changes of the spill? What would you have done differently if you were in charge of the chemical storage plant? Why wouldn't someone want to drink water that smelled like licorice?	What happened in the article "Thousands Without Water After Spill in West Virginia?" In what ways does force induce change in this article? What concepts did you explore as a result of this seminar? How did your seminar experience help you deepen your knowledge about change? Why are the experiences of West Virginia forcing change in you? What will you consider as a career because of the forces and changes of this material? Pretend the community was in charge of the chemical storage plant instead of its previous management, what type of change would you force in training that would have prevented the spill and how would that have changed the community?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.)

Content	Process	Product	Learning Environment
The articles selected are: • Reflective and require a much higher level understanding. • Rigorous and is more complex in nature.	Student centered process is multi-faceted. Students will: • Facilitate the seminar. • Craft the majority of the questions. • Embrace the rules for conducting a Socratic inquiry session.		Students will be grouped in a variety of learning environments: • Peer to peer. • Seminar. • Small group.

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.

As students are entering the classroom they are handed an index card with one word on it. Unannounced to the students, these vocabulary words are in the emergency public service announcement to all West Virginia citizens because of a chemical spill that took place on January 10, 2014. The Elk River was contaminated with a chemical used to suppress coal dust. It leaked into the river system and changed 300,000 lives. People were unable to use their tap water for any use other than flushing toilets and because of this change in water, citizens were forced to alter their lives from that point forward.

Vocabulary words to be distributed are:

Direct
Forceful
Perplex
Serious
Chemical
Stoic
Flush
Force
Enforce
Exception
Bath
Contamination
Wash
Cook
Fire
Commode
Drink
Quality
Don't
Water
Warning
Issues
Governor

While students are receiving these words on the index cards, they are asked to find their names on an anchor chart and stay there until further notice.

Students are word detectives.

For the next 10 minutes students will talk about the words, make predictions how the words go together and create an educated guess on how these words are connected through the action of the story they are about to hear.

Within their group, students are instructed to discuss each of their words with their teammates. The students are also guided to dialog about how these words can turn into a story about change.

Once this open discussion takes place for about ten minutes, all students are asked to choose a spokesperson to connect the words together for what they believe is happening. A dialogue occurs for every group of students.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Then the actual story is told by first playing the public service announcement to the entire student body.

Gov. Earl Ray Tomblin urges affected residents to avoid using tap water after a chemical spill in West Virginia. The basic vocabulary is communicated on national news.

Students then watch a video by Sofia Perpetua from January 10, 2014. [Watch in Times Video »](#)

This story will be unveiled to the students via the Socratic Seminar method as questions are generated after the students read an article entitled, “Thousands Without Water After Spill in West Virginia” and watch the public service message from the Governor. Each student will be instructed to read the article * to each other in their groups. Each group will create a set of questions as a result of the close reading. Questions generated from group members are based on the text and are ones that evoke deep thought.

These questions along with phrases, notes from the close reading and important words are highlighted. Each group member writes the questions and there will be highlighters for students to use for important words and phrases.

Website

*https://www.nytimes.com/2014/01/11/us/west-virginia-chemical-spill.html?_r=0

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

When students have completed their group work, the following questions are asked by the educator.

- What forced the change in water quality for the residents in West Virginia?
- What forced the changes for the people living in West Virginia in January, 2014?
- How might these events force change for the population in West Virginia and for

everyone on this planet?

- Why did changes occur for the residents in West Virginia?
- How did the chemical spill change the area in which it occurred?
- Why would businesses be forced to change because of the changes in people's lives?
- What were the long-term changes of the spill?
- What would you have done differently if you were in charge of the chemical storage plant?
- Why wouldn't someone want to drink water that smelled like licorice?

Educator will let students respond to the questions orally and encourage multiple responses especially because diverse perspectives are allowed.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage, students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Students are introduced to a Socratic Seminar method by sitting in two circles. The outer circle is silent, but observing and taking careful notice of what is being said and the evidence to support what students are claiming to be true. The inner circle will address the concepts of how force induces change in the lives of West Virginians because of the polluted water system. Based on the questions students have written, and the facilitator's guided but non intrusive participation, the dialogue continues and concepts are explored.

(Reference material for students to view and ask questions about.

http://www.hhh.k12.ny.us/uploaded/PDFs/DI_Pdfs/Day_1/hertberg.pdf)

Socratic Seminar consideration rules will be posted in the classroom for all students to be aware of.

The outer circle will then become the inner circle to address additional support of the text and students opinions based on evidence from the text.

The student who has been elected to begin the opening question can do so once all the students are ready with the text in front of them and the outer circle has a checklist with the seminar's observation checklist. If by any chance the student has some hesitation, then the educator can open the seminar with questions such as:

1. What changes are considered the most important in the lives of West Virginians because they were forced to be without drinking water for a very long time?
2. What is the main idea of the article?
3. How is the article related to change?

Students will be allowed to dialogue for 15 minutes and then the outer circle is asked to become the inner circle. The roles of the outer circle are now to create questions and observe the group member they are assignment to.

The dialog will continue for another 15 minutes. The educator will then ask the students:

- What happened in the article “Thousands Without Water After Spill in West Virginia?”
- In what ways does force induce change in this article?
- What concepts did you explore as a result of this seminar?
- How did your seminar experience help you deepen your knowledge about change?
- Why are the experiences of West Virginia forcing change in you?
- What will you consider as a career because of the forces and changes of this material?
- Pretend the community was in charge of the chemical storage plant instead of its previous management, what type of change would you force in training that would have prevented the spill and how would that have changed the community?

As the responses conclude, students are asked to return to their groups where the index cards are.

Evaluate: *This phase assesses learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will work in the groups from which they started. The index cards would be in these groups.

On the index cards are the basic vocabulary words. Students are now asked to rip the card up and create their own set of vocabulary cards with new words from the text and at a deeper level. They are also given a chance to search on follow up stories of the event and gather, research and collect additional images and information pertaining to the January 2014 life changing event.

Note areas to guide students for further information on the event:

- People indicted, arrested and convicted.
- New chemical regulations of uncharted storage of chemicals.
- Health concerns.
- Name some of the changes forced upon West Virginia residents that received their drinking water from the Elk River.

Article One

Thousands Without Water After Spill in West Virginia

By TRIP GABRIEL

JAN. 10, 2014

CHARLESTON, W.Va. — As 300,000 people awoke on Friday to learn that their tap water was unsafe for brushing teeth, brewing coffee or showering, residents and businesses expressed a mix of anger and anxiety in coping with an industrial accident with no clear end in sight.

Schools were closed, restaurants locked their doors and hotels refused reservations. Store shelves were quickly stripped of bottled water, and traffic snarled as drivers waited to fill jugs from tankers delivered by the National Guard.

“It’s worrying me so much I’m having chest pains,” said Cookie Lilly, 71, who waited with her husband to get a ration of four gallons of water at the South Charleston Community Center.

Photo



Freedom Industries processes and stores chemicals used in the coal industry on the Elk River. Credit Tyler Evert/Associated Press

Gov. Earl Ray Tomblin, who ordered the ban on drinking, bathing and cooking with tap water in Charleston, the state capital, and nine surrounding counties, called on people not to panic.

“Help is on the way,” he said in a statement. “There is no shortage of bottled water. Supplies are moving into the area as we speak.”

Asked at a news conference about his “personal hygiene,” the governor sought a touch of levity. “It would be great to hop in a hot shower, but we’ll get through it,” he said. “We’re tough West Virginians.”

Authorities did not know how dangerous the chemical was or how long it would take to flush it from the system. Credit Ty Wright for *The New York Times*

Mayor Danny Jones of Charleston said the do-not-drink order was strangling businesses. “You can’t imagine what it’s like to function like this, or not function like this,” he said, speaking as he drove home on Friday evening in uncommonly light traffic and passed a mall he said was nearly deserted.

The mayor and everyone else said their greatest worry was that no one in authority would say how long it would be before the water supply was potable again.

Officials said that up to 5,000 gallons of an industrial chemical used in coal processing seeped from a ruptured storage tank into the Elk River, just upstream of the intake pipes for the regional water company.

Authorities struggled to determine how much danger the little-known chemical, MCHM, or 4-methylcyclohexane methanol, posed.

“We don’t know that the water is not safe, but I can’t say it is safe,” said Jeff McIntyre, president of the West Virginia American Water Company, which supplies most of the household water in the area. “The only appropriate use for this water is toilet flushing.”

The chemical, which smells like licorice, can cause headaches, eye and skin irritation, and difficulty breathing from prolonged exposures at high concentrations, according to the American Conference of Governmental Industrial Hygienists.

Photo



On Thursday, a worker placed a boom in the Elk River at the site of a chemical leak. Credit Chris Dorst/*The Charleston Gazette*, via Associated Press

Four to six people had been admitted to hospitals for observation with symptoms of nausea, but none were in serious condition, said Karen L. Bowling, secretary of the State Department of Health and Human Resources.

As President Obama declared a federal emergency, Booth Goodwin, the United States attorney for the Southern District of West Virginia, announced that his office and “other federal law enforcement authorities have opened an investigation into the circumstances surrounding the release.”

“We will determine what caused it and take whatever action is appropriate based on the evidence we uncover,” Mr. Goodwin said.

Photo



Shelves were virtually cleared of water bottles at a Kroger in South Charleston. Credit Tyler Evert/Associated Press

The owner of the ruptured tank, Freedom Industries, processes and stores chemicals used in the coal industry in 14 tanks on the Elk River, 2.5 miles upstream from the junction of the Kanawha River in downtown Charleston.

An Environmental Protection Agency report on the chemical facility showed no violations in the last three years.

The state Department of Environmental Protection issued on Friday a violation notice to the company for releasing MCHM into the air, and it ordered all tanks on the site to be emptied and the chemicals moved off site.

Photo



Water was distributed at a school in Charleston on Friday. Credit Craig Cunningham/*The Charleston Daily Mail*, via Associated Press

Gary Southern, the president of Freedom Industries, said the company did not know how the leak occurred. Workers first noticed leakage from a 35,000-gallon tank into a containment area around 10:30 a.m. on Thursday and began a cleanup, Mr. Southern told reporters on Friday.

His account was contradicted by the Environmental Protection Department, which said that the leak was discovered by its inspectors at 11:10 a.m. in response to complaints from residents about the odor, and that when inspectors arrived at the plant they saw chemicals leaching through a containment dike and no cleanup underway.

Mr. Southern, who apologized for disrupting so many lives, said that MCHM was a "very low toxicity" chemical. "If you look at the technical data available, it has no effect on aquatic life."

W.V. Governor Issues Warning on Water

Gov. Earl Ray Tomblin urged affected residents to avoid using tap water after a chemical spill in West Virginia.

[Watch in Times Video »](#)

At one point Mr. Southern tried to end the news conference, citing "a very long day." A reporter, calling out "We're not finished," pointed out that it had been a long day for everyone, especially the people who cannot consume their water. Mr. Southern took a few more questions.

At a Rite Aid near Charleston's downtown, a semi truck delivering bottled water was greeted like Santa's sleigh. A line of 25 people immediately formed to buy the bottles as quickly as they were unloaded.

Residents swapped stories of how they first reacted to news of the tap water ban and how they were making do.

"I was in the bathtub when my wife came in and told me, 'Get out of the tub,' " said Curtis Walls, 60, who moved to the city a few months ago. He said the water that flowed from the tap had a licorice smell. You "can't do nothing" without water, he said. "You don't miss it till it goes away."

Patricia McIntyre, 36, was missing work because her employer, Diana's Downtown Café, was closed. She fretted about losing the hours. She had been having her hair washed at a salon when the radio reported the ban. "I thought my hair was going to fall out," she said.

Article Two

[Emily Atkin](#)

Staff writer @newrepublic, covering science and the environment. Formerly @thinkprogress.

Dec 17, 2014

Four Executives Indicted From Company Behind West Virginia Chemical Spill

The U.S. Attorney General's office has filed an [indictment](#) against four executives of the company that contaminated drinking water for 300,000 West Virginians this past January, alleging violations of the Clean Water Act.

The indictment marks the [second time this month](#) that former Freedom Industries CEO Gary Southern has been charged with violations related to a massive chemical spill that saw 10,000 gallons of a coal-cleaning chemical called crude MCHM dumped into West Virginia's Elk River. Also named in Wednesday's indictment are company ex-president Dennis Farrell, former secretary William Tis, and onetime vice president Charles Herzing.

Freedom Industries' executives are accused of "fail[ing] to exercise reasonable care in its duty to operate the [chemical storage facility] in a safe and environmentally-sound manner," and that their failure to exercise care was the primary reason for the historic spill.

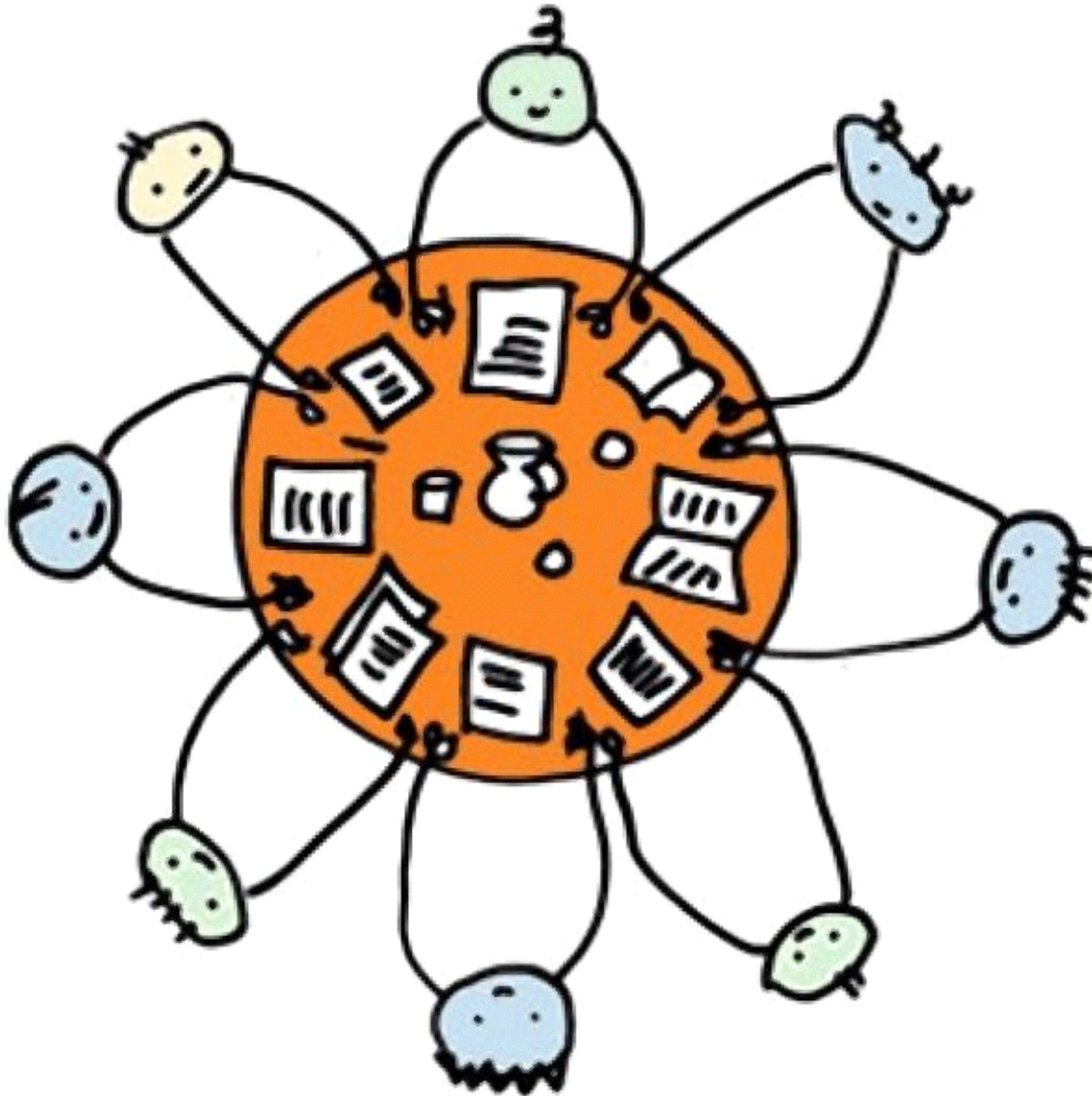
"It's hard to overstate the disruption that results when 300,000 people suddenly lose clean water," U.S. Attorney Booth Goodwin said at a news conference, according to the [Associated Press](#). "This is exactly the kind of scenario that the Clean Water Act is designed to prevent."

The indictment brings Farrel, Tis, and Herzing into the public eye as figures allegedly responsible for the spill, which left 300,000 West Virginians without drinkable water for five days, though uncertainty surrounding whether the chemical was fully removed has left many residents still wary to drink the water.

Southern, however, had been at the center of the incident since it began. The day after the spill was discovered, he held a press conference, but [attempted to excuse himself](#) multiple times while being asked questions by reporters. He then took a sip of bottled water in front of the news cameras, an image many thought “[brazen](#)” considering his company was preventing others from that very luxury.

Southern was also scrutinized in March for [asking for compensation](#) while he worked during Freedom’s company bankruptcy. Southern said he had been working 12–16 hours every day and deserved to be paid. But local environmental leaders scoffed, saying he had been “out of the picture since day one of this crisis.”

Then, earlier this month, Southern was [arrested and charged by the FBI](#) with bankruptcy fraud, wire fraud, and lying under oath during the company’s bankruptcy proceedings following the massive spill.



Socratic Seminar-Discussion Observation Checklist

RECORD A CHECK FOR EACH TIME YOUR PARTNER CONTRIBUTES:

Name of person you are observing: _____

Your name: _____

Seminar Topic: _____ -

RECORD A CHECK FOR EACH TIME YOUR PARTNER CONTRIBUTES:

Dialogs in the discussion – speaks loudly and clearly _____

_____ Stays of topic? _____

Talks directly to other students rather than the teacher? _____

Stays focused on the discussion? _____

Invites other people into the discussion? _____

Makes eye contact with speakers _____

Refers to the text - Cite reasons and evidence for his/her statements with support from the text?

Asks a new or follow up question _____

Responds to another speaker by listening to others respectfully in a polite manner? _____

Paraphrases and adds to another speaker's ideas _____

Encourages another participant to speak _____

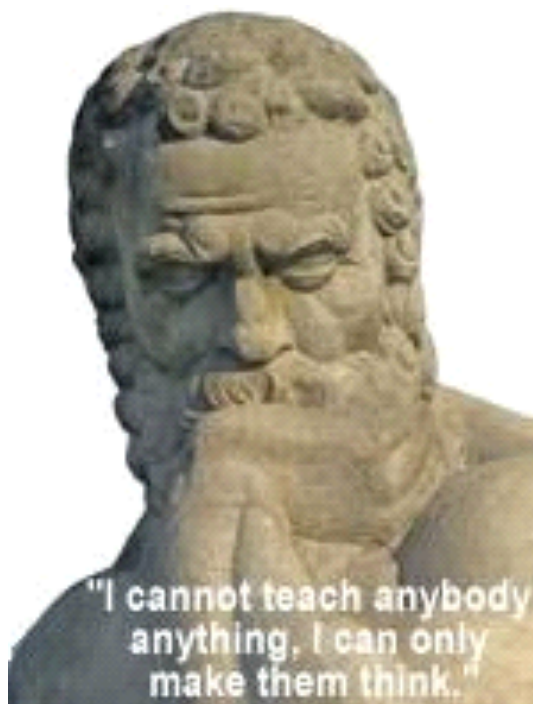
Interrupts another speaker _____

Engages in side conversation _____

Dominates the conversation _____

AFTER THE DISCUSSION, WHAT IS THE MOST INTERESTING DISCUSSION POINT
YOUR PARTNER SAID?

AFTER THE DISCUSSION, WHAT WOULD YOU LIKE TO HAVE SAID IN THE
DISCUSSION?



TEACHER NAME		Lesson #
Mrs. Sharon Hale		3
MODEL	CONTENT AREA	GRADE LEVEL
Project Based Learning	Science	4-5
CONCEPTUAL LENS		LESSON TOPIC
Change		Storm Drain Water Filters
LEARNING OBJECTIVES <i>(from State/Local Curriculum)</i>		
4. L.1 Understand the effects of environmental changes, adaptations and behaviors that enable animals (including humans) to survive in changing habitats. 4. L1.3 Explain how humans can adapt their behavior to live in changing habitats (e.g., establishing storm drains and water filtering systems to prevent flooding and erosion). - North Carolina Essential Standards 3-5 Science 5th Grade Science as Inquiry As student's progress through the grade levels, their strategies for finding solutions to questions improve as they gain experience conducting investigations and working in small groups. They are capable of asking questions and make predictions that can be tested. 5.V.3.1: Evaluate how to manipulate tools safely and appropriately to reach desired outcomes. - SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly. Speaking and Listening: Flexible communication and collaboration Including but not limited to skills necessary for formal presentations, the Speaking and Listening standards require students to develop a range of broadly useful oral communication and interpersonal skills. Students must learn to work together, express and listen carefully to ideas, integrate information from oral, visual, quantitative, and media sources, evaluate what they hear, use media and visual displays strategically to help achieve communicative purposes, and adapt speech to context and task.		
THE ESSENTIAL UNDERSTANDING <i>(What is the overarching idea students will understand as a result of this lesson?)</i>		THE ESSENTIAL QUESTION <i>(What question will be asked to lead students to "uncover" the Essential Understanding)</i>
<i>Force induces change</i>		<i>How does force induce change?</i>
CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)		PROCESS SKILLS (What will students be able to do as a result of this lesson?)

Students will learn: • How engineering design can be a regular part of problem solving to change water systems. • Experience similar scientific and engineering practices as those used by professionals in the field. • How matter moves through ecosystems in different ways to force changes. • Ground water contamination is likely caused by human activities. • How contaminants present in surface waters can contribute contamination to ground water system. • How water entering soil may have a variety of constituents that require removal prior to reuse. • PH levels are related to healthy water for living things. • The meaning of the word constituent. • Chemical reactions forces filtration and changes water quality.	Students will be able to: • Organize thinking through problem solving • Prioritize time to discuss problems • Remove constituents from water prior to reusing the water. • Analyze PH levels in the reused water prior to filtration and post filtration. • Develop a deeper understanding of science beyond memorizing facts. • Collect data through investigation. • Evaluate cognitive models of matter results. • Collaborate with peers.	
GUIDING QUESTIONS <i>What questions will be asked to support instruction?</i> <i>Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding</i>		
Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:

What is debris?

- How does debris enter water systems?
- How does debris change water quality?
- What types of debris forces changes in water quality?
- How does debris change groundwater?

Why is a filtration system needed for change?

- What filtration methods force changes to local towns and cities?
- What is a storm drain and how do storm drains force water flow to ensure clean water?
- What happens to water after it leaves a storm drain?
- What materials will force water to change as it goes through a water system?
- How would these changes to water quality compound if rainfall is forceful?

What is an aquifer?

- How does groundwater relate to an aquifer?

- What changes occur as debris changes?
- After your initial discussion, what do you think the problem is that is changing the water filtering systems?
- Why does your group need to ponder the forces of objects and their sizes?
- What do you need to know more about to continue forcing a change to resolve this problem?
- What are you doing that will induce positive changes?
- Why do you think this is the problem?
 - How is the water quality changing as your filtering systems change?
- What evidence do you have to show changes in water quality are directly related to filtering systems?

- How did the water filters you constructed induce change along the journey to clean water?
- Why did changes occur in the water after the removal of debris?
- What materials worked best to induce change in water quality?
- Why do engineers want to force change for clean water?
- How did liquids and solids move through the ecosystem?
- Why was the problem solved?
- What changes occurred?
- What forces helped make these changes?
- How did your group grapple with the complexity of change?
- What forced you and your group members to use prior knowledge to force changes in the problem solving?
- Knowing when the rains force water flow, how would you solve that problem? What would you include in the construction directions for others to prepare?
- How can engineers share their ideas to solve problems that need to force change?

DIFFERENTIATION <i>(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.</i>			
Content	Process	Product	Learning Environment
It lends to healthy perspectives about topics based on a real world audience.	Hands-on inquiry based process which encourages questioning and deep level thinking offering challenges to gifted students. Builds foundational questioning skills which build upon prior knowledge		Student-centered authentic engagement based on problem solving with critical elements of collaboration through teamwork requiring building upon others ideas and thoughts.

PLANNED LEARNING EXPERIENCES

(will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

The educator starts the class by letting students \walk around piles of debris on the classroom floor as if it was an art gallery. There are:

Large items: tree branches, bark and twigs

There are waste and trash objects: plastic, grass clippings and shredded paper

Smaller objects: soil, sand and rocks, pebbles, fertilizer pellets and liquid pollutants such as oils

The educator introduces piles of debris as common debris from roadways. This is accomplished as the educator guides students in debris discussions using some guided questions.

What is debris?

- How does debris enter water systems?
- How does debris change water quality?
- What types of debris forces changes in water quality?
- How does debris change groundwater?

Why is a filtration system needed for change?

- What filtration methods force changes to local towns and cities?
- What is a storm drain and how do storm drains force water flow to ensure clean water?
- What happens to water after it leaves a storm drain?
- What materials will force water to change as it goes through a water system?
- How would these changes to water quality compound if rainfall is forceful?

What is an aquifer?

- How does groundwater relate to an aquifer?

Lead students to the discussion on the purpose of storm drains. Discuss where the water and objects that flow into a storm drain goes and how this force can change water quality. Have students list all of the objects in the piles of debris in the classroom they can think could enter the water systems because there were no water filters.

Students will investigate how a flume works.

Using long tubes, students pour water through the tubes that drains into a bucket, which represents a body of drinking water.

To represent what happens when storm water enters a water system, students will place forms of debris from the classroom piles into the water and then they perform the flume procedure again.

The educator asks if the students observe whether or not the water appears different. Students will discuss their observations based on the changes that occurred. The quality of the water may appear different and then this will give students a visual representation of how storm drains collect objects as they are forced down systems.

How would these changes to water quality compound if rainfall is forceful?

Students will know and understand that without water filters the debris would change water quality as it empties into the river and lake systems. Students will know from the discussions, the force of such storms pushes items from surrounding areas into storm drains. Without filters, these drains take on all debris which can then end up in the aquifers as dirty water.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Water Heroes are placed into groups by the groups of debris.

Problem Engagement

Summer vacation for all students has arrived! The Storm Center has predicted a sudden major rainfall, wind and possible hurricane conditions for the next week in Durham.

It is hot, sticky and the weather makes it feel like the temperatures are over 100 degrees. Your family mentions there are major storms coming. They have this look of on their faces. Being an astute water hero, you begin to think, why they are reacting to the storm warnings because we have had severe weather in the past.

Wait a minute, there is a bigger problem.

The storm drains in your town are not equipped to handle the debris that flows from roadways because the filters are gone. No one knows what has happened to all of them. Rumors are forming, but you don't have time to listen to them. Rain is on the way! The water treatment plants are working overtime already even before the storms come. The tap water is starting to smell and look funny. The citizens are rushing to the stores to buy up all the bottled water on the shelves. Before you know it, that water is gone. Durham needs clean water. Water heroes, build those filters.

Inquiry and Investigation

Based on the engage and connect experiment, the educator will ask these pointed questions to students:

Why are the water heroes being called to action?

What do you know about water flow and how could it change everyone's lives if filters are not part of system?

What forces will occur because of the missing filters?

Now it is time to clean the water.

Students will construct various types of filters that will address cleaning out various types of debris. Students will collaborate and share what they have found as they continue to recycle the water through their filter system. Students will record levels of changes in the water by cloudiness, particles and color. Students will also determine how many tests they will need to conduct in an effort to obtain clean water.

Educator will:

1. Review key elements of water filters from past experiences.
2. Lead students to a table with materials to construct water filters. These materials are very different from what was used to filter dirty water in the creative problem solving devices.
3. Distribute a map of a section of Durham where storm drains exist as a reference point.
4. Provide time for students discuss the problem and the intricate parts on how to begin to solve this problem. Possibilities for design are important for these groups and there should be a time keeper checking on the amount of time left to conduct research.

Problem Definition

I. Anchor charts are located in each group. The charts are a way to organize the students' thinking. These charts will also be a central place where the problem is defined by group members, have questions from group members, have ideas from the group members as well as sketches and illustrations to worked through and solve the problem.

Every group of students will have a chart with the headings:

What problem do we need to solve?

What supplies will we use?

What is our plan?

What worked for us:

What did not work for us:

This is what our final water filter looks like.

What forces induced change in water quality?

The group members will then visualize their steps to solve the problems and find solutions to the problem that drives their learning.

II. Students will restate the problem by listing their next steps as they investigate the reasons behind their decisions. The anchor chart at each group will reflect their time line of problem solving steps.

III. Materials management: Group members will receive a box of materials to help solve their defined problem. These materials are manufactured and sold in stores. The group members are made aware that some of the materials may be recognizable.

The educator will “check in” but not intrude on their problem solving methods. The facilitator is prompting students, “What is happening here in this group? What do you continue to wonder about? What are you thinking that will force change?”

Prompting, however never giving the solution. Visually seen, but then fades into the background. Always aware of the buzz of problem solving, keenly listening from a distance. Always asking why questions to the students when they are wondering, “why would your thinking lead you in this direction?” Letting students become and maintain their empowerment. Never judging, only encouraging solutions to the problem at hand. What short-term changes could force a decision to solve the problem at hand? What about the long-term forces and changes?

When questions from students arise, the educator will always show the responsibility to solve the problem falls on their engineering prowess.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Problem Resolution

How did your group grapple with the complexity of change? What forced you and your group members to use prior knowledge to force changes in the problem solving?

Knowing when the rains force water flow, how would you solve that problem? What would you include in the construction directions for others to prepare?

How can engineers share their ideas to solve problems that need to force change?

Students are asked to continue to write questions and post them on the charts with a specific answer in mind, but to also be aware that further discussions will occur as other groups can share their questions.

Do you have a hunch about some of the answers to these questions now that others have shared them?

What does this problem remind you of in a previous learning?

Problem Debriefing

The educator will explain how change occurred in water quality based on filters at multi stages of the storm drain systems that created positive changes in the citizens’ water supply. The process is not perfect and takes many planned steps to provide clean drinking water.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.*

Students are encouraged to present their findings and elaborate on how there were changes in the water as their filters removed debris. Students will reflect upon how their group made changes that forced debris removal. Students will understand the process of removal is connected to many

problem solving decisions and trials. Students ask if any students from other groups have questions for them. Students then begin reflecting among their own group members what they learned from the experience and how they will view storm drains from a new perspective based on their exposure to the problem solving session as water heroes.

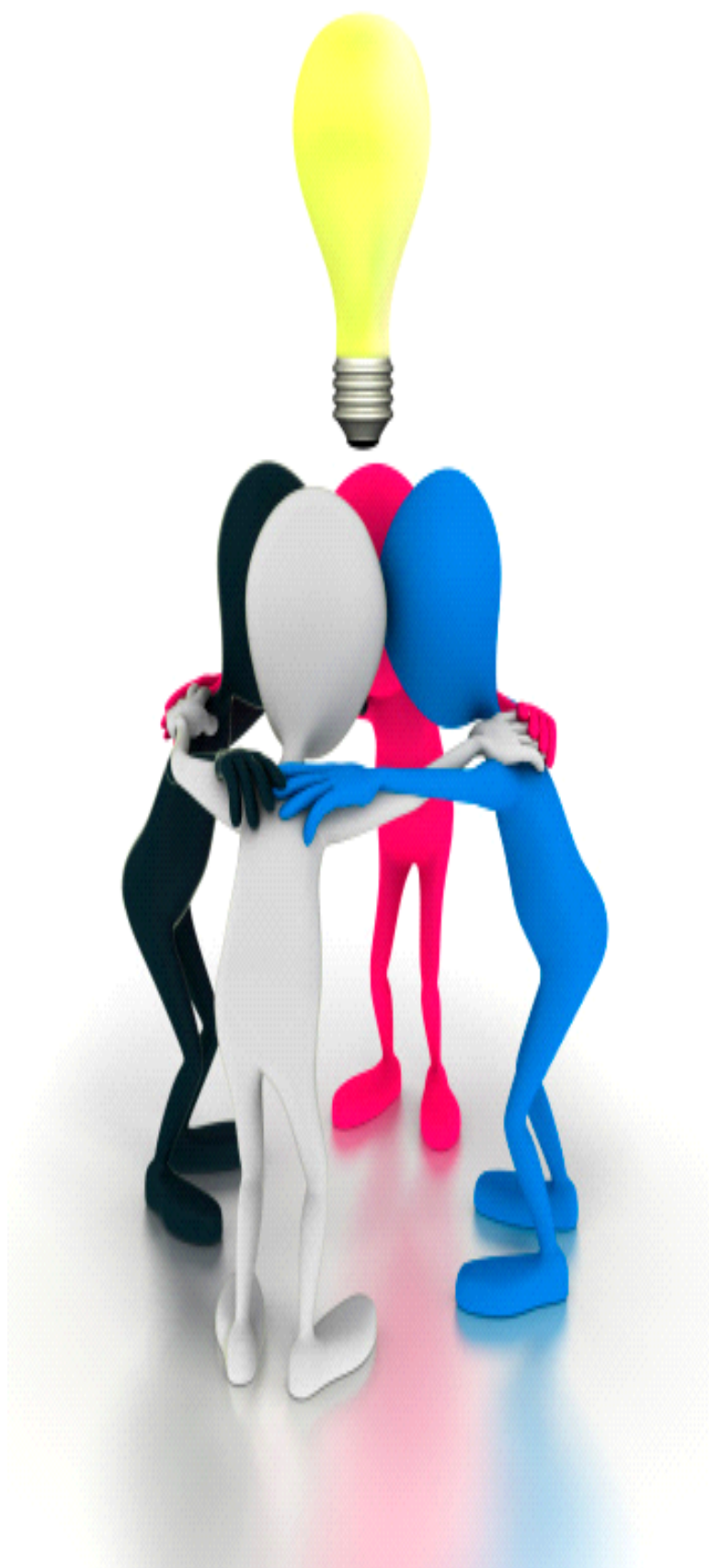
Evaluate: *This phase assesses learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Informal assessments throughout all of the questioning sessions will be used to determine student understanding. The collaborative efforts which each student played an important role in the solutions to the problem is valued as much as the presentation of the final solution to other group members. Students will address how force induces change in their presentations from the perspective of the natural forces that move water and the advocacy perspective for which they forced changed.

Finally, a critique of their own role in the process as they evaluate what it felt like to be a problem solver. A written statement that would be included on a medal which they would design to wear around their neck as they leave the classroom for the day.

GRAPHIC ORGANIZER

STEM CHALLENGE GRAPHIC ORGANIZER



TODAY MY CHALLENGE IS:

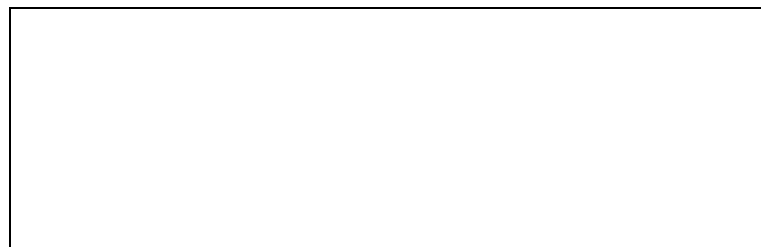
WHAT SUPPLIES WILL I USE?

WHAT IS MY PLAN?

WHAT CHANGES WORKED FOR ME?

WHAT CHANGES DID NOT WORK FOR ME?

**THIS IS WHAT MY FINAL PROJECT
LOOKS LIKE:**



WHAT I LEARNED ABOUT FORCE INDUCESCHANGE:

WHAT CAN I CONCLUDE ABOUT FORCE INDUCES CHANGE?

TEACHER NAME		Lesson #
Mrs. Sharon Hale		4
MODEL	CONTENT AREA	GRADE LEVEL
BRUNER	SCIENCE	3-5
CONCEPTUAL LENS		LESSON TOPIC
CHANGE		Water Quality
LEARNING OBJECTIVES (from State/Local Curriculum)		
SCIENCE: 3rd Grade & 4th Grade 3. E.2.1 Students know there are bodies of water on the surface of the earth and they are often named based on their characteristics and location. Some bodies of water are salty, some are 'fresh', some are 'brackish', and some are frozen in ice sheets and glaciers. Different types of organisms have developed to live in these different bodies and types of water. 3. L.2.2 Explain how environmental conditions determine how well plants survive and grow. 4. P.2 Understand the composition and properties of matter before and after they undergo a change or interaction. 4. P.3 Recognize energy takes various forms that may be grouped based on their interaction with matter.  - Observe, speculate and identify crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; energy and matter; and systems and systems models are called out as organizing concepts for these disciplinary core ideas. 5-PS1-3. Make observations and measurements to identify materials based on their properties. 5-PS1-2. There is existence of connections to nature of science and scientific knowledge. There are patterns in natural systems to observe and use for scientific decisions through observations. SOCIAL STUDIES Essential Standards: 5. G.1.3 Exemplify how technological advances (communication, transportation and agriculture) have allowed people to overcome geographic limitations. 5. G.1.1 Explain the impact of the physical environment. Physical environment can determine the way people meet basic needs.		
THE ESSENTIAL UNDERSTANDING (What is the overarching idea students will understand as a result of this lesson?)		THE ESSENTIAL QUESTION (What question will be asked to lead students to "uncover" the Essential Understanding)
Force induces Change		How does force induce change?

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)		PROCESS SKILLS (What will students be able to do as a result of this lesson?)
Students will learn: • The Scientific Method is a way to explain why things happen or not happen. • They are scientists when they question, identify problems and find solutions to help change a problem to a solution. • Questioning the problems force the scientific method. • Forcing changes contributes to the scientific method to view what if statements. • Water quality changes living things. • Water quantity changes living things. • Water types force changes in in living things. • Researchers use specific tools and methods to force change. • Accurate data collection highlights trends. • Trends force change. • Relationships change. • Changes are observable and comparable. • Changes force questions. • Human Interactions change outcomes. • Key terminology and phrases. • Possible things that force change. such as: perspective, observation, investigation, relationships and patterns.		Students will be able to: • Formulate answers to their questions based on perspective. • Recognize attributes in water quality. • See relationships by making observable pattern connections. • Note subtleties. • Evaluate speakers' point of view. • Focus on specifics. • Note what needs to be remembered. • Identify appropriate sampling techniques. • Draw conclusions and make generalizations. • Illustrate examples, and relevant information.
GUIDING QUESTIONS <i>What questions will be asked to support instruction?</i> <i>Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding</i>		
Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
• Where do scientists work? • What do they need in their working environment? • What dispositions do scientists need?	• How is observation viewed from the perspective of a change agent? • What is meant by water quality changes and	• How do scientists observe change? • Imagine you can add a step to the scientific method what would it be? • Explain how this new

• What rules do scientists follow? • In what ways do scientists communicate to force change? • What do scientists do to induce change? • What mission statements do scientists make to force change? • What tools do scientists use and for what reasons to test change?	how do you know? • How does matter change? • What forces matter to change? • Why is changing matter informative in the scientific method? • When matter changes, what information is provided? • How does communication force change? • How much water can be estimated to force change? • How do substances inform scientists about change? • Why is force part of a scientist's job? • How does matter cycle through ecosystems?	step would force change? • What would happen if questioning was eliminated in the scientific method? • What did you learn about yourself as a scientist? • How can students all over the world force changes when they think like a scientist? • How does force induce change as a scientist?
--	---	---

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.)

Content	Process	Product	Learning Environment
Students are asked to structure their knowledge of a subject in a way they understand permitting them to make meaning across domains.	Students are asked to think critically through inductive reasoning, points of view and missing information by applying the scientific method to discover and make conclusions from inference.		Collaborative dialog within peers, groups and independently meeting their preferences toward understanding.

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

The educator greets the students dressed as a scientist holding a test tube with liquid, a white lab coat and wearing protective gloves and goggles. The educator is wearing a name tag which reads California Growers Association Laboratory.

The educator announces: WELCOME BACK WATER HEROES. It is also written on the white board. The educator's instructions are for students to group together with those in their water hero first day session. As a reminder there is a chart that lists every group number and every water hero name in by group number.

Brainstorming Sessions

Once the water heroes greet one another, the educator announces their task is to generate what they know about scientists. They are asked to use their experiences throughout the week and any all information they expect they know about scientists.

Their brainstorming list should include responses to pre- lesson questions. These pre-lesson questions are provided to each student. Attached to the questions is a blank sheet. They are to fold the sheet into equal thirds and then fold the equal thirds in half. There should now be six equal spaces for students to write in. They are to write their responses to each question and make notes while brainstorming with their group members.

Pre-lesson questions are:

- Where do scientists work?
- What do they need in their working environment?
- What dispositions do scientists need?
- What rules do scientists follow?
- In what ways do scientists communicate would to force change?
- What do scientists do to induce change?
- What mission statements do scientists make to force change?
- What tools do scientists use and for what reasons to test change?

After 5 to 10 minutes the students are allowed to brainstorm, the educator invites all students to respond. The educator will receive their ideas and thoughts. The educator will write them on the white board. All students will see and ask questions or elaborate on responses.

The educator wants to encourage more responses in order to generate a healthy list of ideas from the six pre-lesson questions. Once this is accomplished, then students are asked to take notes from the board to complete their lists.

During the session, each response is positively affirmed and the educator continues to confirm there are no wrong answers during the brainstorming sessions.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

The educator makes a formal introduction of the two characters in the video. The educator explains these two characters as their new comrades in action. These characters had been given the same set of questions to respond to prior to today. Tim and Moby are water heroes from a distance learning perspective and will let you know what they know. Ready, set go...

We begin to listen to what Tim and Moby know about the six questions. (See printed copy of "SCIENTIFIC METHOD MOVIE TRANSCRIPT.")

The educator starts the 10-minute video.

<https://www.brainpop.com/science/scientificinquiry/scientificmethod/>

After the video, the educator refers back to the original list. The educator poses the question: what other things would you add to this list based on what you learned from your two new water heroes, Tim and Moby?

The students are able to respond. Information is added to the list.

Students are in placed in their groups. The educator lets them know they are to think like water hero scientists.

The educator has set up four science stations. These science stations are revealed and numbered. Stations 1-4 will indicate how much well water from groundwater sources it takes to bring crops to maturity in the United States.

The science stations, which are all differentiated, are replicas of science labs. There are tools which are found in typical science labs such as microscopes, magnifying glasses, test tubes etc. Included are samples of well water from a local community in California. Each sample of well water is labeled.

Each station also has a set of chemicals which test for contaminants.

Included in the water testing trays are exposed contaminated well samples as well as and uncontaminated well samples.

Within each station there are photographs of living and nonliving plants.

Students will also see pictographs that indicate the amount of gallons of water it takes to grow each plant.

What each station represents is change. Force induces change.

Students are provided the necessary tools needed for writing. A field note graphic organizer, writing tools to diagram, color pencils and sticky notes.

Students rotate to each station number and think like a scientist as they carefully, and silently, take notes on their graphic organizer.

At each station there is also an anchor chart which reminds students to:

1. Notice silently, deeply and critically changes and forces,
2. Write about changes and forces silently, deeply and critically.
3. Move from station to station safely to think about changes, forces as a scientist.

Explain – *Students communicate what they have learned so far and figure out what it means. This phase also provides opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

After students move from station to station and record the changes, they are provided time and allowed to gather in their groups to discuss what they noticed.

Each group shares:

- Generalizations about what might have forced these changes.
- Inferences from the perspective of scientist.
- Additional questions.
- Reports and conclusions

The educator encourages students to dig deeper with concepts and transfer their knowledge to how these changes apply to people all over the world in different areas and with different water conditions.

This important connection to social studies and science standards makes their learning all week applicable.

The educator does this asking students the following questions:

- How do scientists observe change?
- Imagine you can add a step to the scientific method what would it be?
- Explain how this new step would force change?
- What would happen if questioning was eliminated in the scientific method?
- What did you learn about yourself as a scientist?
- How can students all over the world force changes when they think like a scientist?
- How does force induce change as a scientist?

Students respond to questions orally. Answers are discussed and noted on their working documents.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.*

Students are separated into new groups.

With their new group members, students highlight the ways they felt as a scientist as they rotated through each station. The students are instructed to compare and contrast what they highlighted on the transcript, foldable and graphic organizer called field notes with their new group members.

By highlighting all the new information with a new color highlighters, they will notice new perspectives from their fellow scientists. They will then be able to discuss these differences and similarities with their new group members.

The following are points the educator will tease out if they were not in former discussions:

Many types of matter is found in testing labs.

Matter is an observable substance.

There are forced changes to the matter by human intervention.

When there are limitations of water from wells, food would be limited.

Water from wells end up used to grow food and therefore needs to be tested for quality.

Wells are considered a water transportation system.

Water from wells is not universal given.

Large quantities of water are needed to grow food we consume daily.

Survival depends on water access.

Human consumption is associated with the amount of water needed to grow the food.

Observation is a powerful tool to understanding connections with water and food as a human need for all.

Perspectives are critical to understanding water quality and human needs as changes to water resources.

Process Skills:

How to formulate answers to their questions based on perspective.

How changes influence perspective.

How to ask questions from a specific perspective.

How to visualize objects as their perspective and point of view.

How to connect prior knowledge to perspectives.

How students can force changes knowing how to think like a scientist?

Evaluate: *This phase assesses learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Tim and Moby appear back on the screen.

In a different group, students will pretend they are playing the part of Tim and Moby's new scientist friend and will appear in a new video. Students write their parts by illustrating themselves as a scientist and writing three to five statements that evaluate would answer the following:

How does force induce change?

Students are provided a story board called a pinch card. A pinch card allows for creases in a strip of paper. There are simply four pinches to a strip of paper. Students would quickly jot down what they would say in each pinch. All of these story boards will be read to group members as they work together and bounce ideas off of one another.

These story boards can be used in the performance task.

(**Irrigation water** can **come from** groundwater (extracted from springs or by using wells), from surface **water** (withdrawn from rivers, lakes or reservoirs) or from non-conventional sources like treated wastewater, desalinated **water** or drainage **water**.

Tips: Be subjective, emphasize hunches and impressions, include unanswered questions, correct mistakes and misunderstandings from other field notes include insights and speculation

Evaluate Stage-Field Notes Graphic Organizer – Think Like A

Reflective Notes:
Descriptive Notes

- What rules do scientists follow?



rules



What words
are specific to the work of a
scientist?

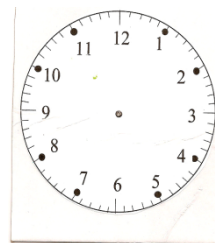


Patterns

What ongoing forces contribute to change?

V. PERFORMANCE TASK

How and why do things change overtime?



Water Departments across the world are searching for a wake-up call to all citizens on this planet about a potential water crisis.

You are now a clean water expert. People across the world can benefit from what you have learned and now it is time to share that knowledge. Are you ready to answer that call?

To do that, we are asking you to put together a poster that will act as a public service message remembering what you learned as you took murky, dirty water and cleaned it through a filtering system you designed. Also, the poster can reflect your feelings as if you did not have clean water yourself.

Along with your creative ideas and illustrations, view this as a learning tool from a global perspective. Think deeply. Imagine if your poster was chosen as the one to go in every classroom around the world! What would you want to show the world?

Let your poster develop everyone's awareness that change happens because a hero has forced everyone to think deeply about clean water. Because of your questions, investigations and participation problem solving, you will force changes for all to have access to clean water.

Oh, yes, heroes, as an added bonus, you will have the opportunity to present your poster to panel members, one of which is a book reviewer and local columnist for the News and Observer newspaper. As water heroes present their poster in a 3 to 5 minute time frame, all participants receive recognition for their advocacy with a certificate.

Use the Suggested Poster Design Rubric as a guide.

VI. Unit Resources

Books and Textbooks and Research Articles

- Abubakar, Abbas Babayi, Arshad Mohammad Yusof, (2015), 70 Self-Directed Learning and Skills of Problem-Based Learning. Internal Educational Studies; Vol. 8 No. 12. Canadian Center of Science and Education.
- Berger, Melvin (2000). Scholastic Science Dictionary, SCHOLASTIC INC. New York, New York, Toronto, London, Auckland Sydney, Mexico City, New Delhi, Hong Kong and Buenos Aires.
- Berger, Warren (2014). A More Beautiful Question, The Power of INQUIRY To SPARK BREAKTHROUGH IDEAS. Bloomsbury Publishing Plc. United States of America.
- Erickson, Lynn H. (2007). Concept-Based Curriculum and Instruction for the Thinking Classroom. Sage Publications Co.
- Karademir, Ersin, (Summer 2016). Investigation the Scientific Creativity of Gifted Students Through Project-Based Activities, International Journal of Research in Education and Science Vol. 2, Issue 2. Osmangazi University, Turkey.
- Karnes Francis A., Stephens Kristen R. (2008). Achieving Excellence Educating the Gifted and Talented. Pearson, Merrill Prentice Hall, Upper Saddle River New Jersey & Columbus Ohio.
- Ruef, Kerry & Melody, David (1986). The Private Eye, 5X LOOKING / THINKING BY ANALOGY, The Private Eye: a Wonder Curriculum, pg. 15, 158.
- Shoveller, Herb (2006). Ryan and Jimmy, And the Well in Africa That Brought Them Together. Kids Can Press Ltd. Canada and the U.S.
- Strauss, Rochelle (2007), One Well, The Story of Water on Earth, Kids Can Press Ltd. Toronto, Canada and the U.S.
- Verde, Susan & Badiel, George, (2016) The Water Princess, Random House, Ltd. New York, New York.
- Wiggins, Grant & McTighe, Jay (2011), The Understanding by Design Guide to Creating High- Quality Units. Association for Supervision and Curriculum Development, United States of America.

Web Resources:

- North Carolina State Standards Department of Public Instruction Curriculum, Governmental Environmental Standards and Engineering Activities:

<https://www.dpsnc.net/cms/lib/NC01911152/Centricity/Domain/137/AIG%20Plan.pdf>

<http://www.dpi.state.nc.us/docs/cte/curriculum/essential-standards.pdf>

<http://www.ncpublicschools.org/docs/stem/resources/engineering-connections/gradesk-5.pdf>

<http://www.raeng.org.uk/publications/reports/thinking-like-an-engineer-implications-summary>
www.tryengineering.org

<https://www.epa.gov/sites/production/files/2015-08/documents/mgwc-gwc1.pdf>

<https://www.epa.gov/laws-regulations/history-clean-water-act>

https://www.teachengineering.org/activities/view/uoh_cleandrink_activity1

<http://www.ncpublicschools.org/docs/ccsa/conference/2013/presentations/76.pdf>

<http://www.dpi.state.nc.us/docs/curriculum/languagearts/scos/ncscs-ela.pdf>

<http://www.dpi.state.nc.us/docs/curriculum/languagearts/scos/0417-adopted-ela-standards.pdf>

<https://www.readworks.org/article/Pollution-and-Conservation/8dce5855-f219-4e23-9831-86314ab55bbf#!articleTab:content/>

- Water Flow:

What happens to water and where does water go when it goes down a drain?

<https://www.youtube.com/watch?v=emaver2rkaM>

How is groundwater and irrigated water related?

<https://www.google.com/search?q=where+does+irragated+water+come+from>

Ways to construct homemade water filters at home.

<http://science.lovetoknow.com/science-fair-projects/homemade-water-filter-science-project>

- Scientific Method

Animated informational resource

<https://www.brainpop.com/science/scientificinquiry/scientificmethod/>

<https://www.ibm.com/developerworks/rational/library/mar05/bittner/index.html>

<https://www.videoblocks.com/video/scientists-working-in-the-lab-nvcuf6eigikyw13hu/>

- Non-fiction Informational Text

<http://files.eric.ed.gov/fulltext/ED474306.pdf> Van Tassel-Baska, Joyce (2003). Differentiating the Language Arts for High Ability Learners, K-8. ERIC Digest Arlington, VA.

www.ReadWorks.org Water Worries <https://www.readworks.org/article/Pollution-and-Conservation/8dce5855-f219-4e23-9831-86314ab55bbf#!articleTab:content/>

https://www.nytimes.com/2014/01/11/us/west-virginia-chemical-spill.html?_r=0 Thousands
Without Water After Spill in West Virginia and News Conference New York
Times reporter Trip Gabriel.

<https://thinkprogress.org/four-executives-indicted-from-company-behind-west-virginia-chemical-spill-c1caf788917a> Four Executives Indicted From Company Behind
West Virginia Think Progress reporter Emily Atkins.

info@newsela.com Newsela Daily [info@newsela.com] Water Woes

Photography/Photographers

Parrott, Laura, Durham Public Schools
Stephens, Kristen R., Duke University