

Ground Watery Mystery

Lesson Overview

This lesson introduces students to an ecological problem that involves listening to the opinions of others and then brainstorming a solution. (This is a modification and compilation of introductory lessons to PBL units developed by The Keystone Center, the “Trouble in Fruitvale” kit by SEPUP and “A Grave Mistake” from Project WET, Water Education Foundation. *Information about these materials are provided in “References” below.*) *NOTE: Materials attached to this lesson have been created by the S²TEM Centers SC to avoid the use of copyrighted material. The lesson has been altered where necessary to avoid copyright infringement and to support new materials.*

SC Standards Addressed

7.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

7.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

7.EC.5A In all ecosystems, organisms and populations of organisms depend on their environmental interactions with other living things (biotic factors) and with physical (abiotic) factors (such as light, temperature, water, or soil quality). Disruptions to any component of an ecosystem can lead to shifts in its diversity and abundance of populations.

Disciplinary Literacy

Strategies Used: Collaborative Groups, Bounce Cards, Graphic Organizers, Agree/Disagree (modified – *Pear Deck* and Casual Factors), Active Listening, MIP (Most Important Point)

Computational Thinking

Problem Based Learning (PBL)

Cornerstone(s) Addressed:

- Abstraction: Students will have to determine which information and facts to use in defense of their position, and which information could be potentially detrimental to their position. In addition, they will also need to know what information can be discarded.
- Decomposition: Students will break apart the news article to identify possible sources of illness.
- Pattern Recognition: Students will try to find patterns in the patients’ symptoms and information to help narrow down the investigations that should be completed.
- Abstraction: Students will need to ignore unlikely scenarios or scenarios that cannot be scientifically proven.

Lesson Plan

Time required: Three 90-minute class periods

Focus Question(s): What are the possible causes of the illness plaguing Anywhere, SC?

Disciplinary Vocabulary: Ground Water, Toxin, Contamination, and Sampling (Certain medical terms may need to be discussed, like chronic poisoning, as well as the function of certain companies, like what a meat processing plant does.)

Materials needed:

- Chromebooks (or other devices) with Internet access – (1 to 1 or at least in pairs)
- Pear Deck (A “How To” video for Pear Deck can be found in Resources) account (for teacher; students can access with code) – Classroom interactive software (use any surveying or polling software)
- Opinion statements to use for creation of Pear Deck activity (attached; can be modified to include any opinion statements)
- Individual student copies of 'The Anywhere' news article and 'Possible Causes' graphic organizer (*plus one additional graphic organizer per team*)
- Overview of Water-related Diseases and Contaminants (attached)
- Anywhere SC Map (attached; can be modified)
- Role Cards (attached; can be modified)
- Information Cards (attached; can be modified)
- Causal Factors: Debate Walk-through teacher guide (attached)
- Rubrics – team debates and peer (attached; can be modified)
- Jigsaw Articles (attached, can be replaced)

Engage Students will log into a Pear Deck (*see Resources*) that the teacher has prepared with opinion statements. Students will read the statement(s) and move the dot to the thumbs up if they agree, thumbs down if they disagree, and horizontal if they agree with some aspects and disagree with others. Ask students at each spot on the continuum to explain why they agree or disagree. (Note: This is a debate with more than one correct answer. Teacher should be a neutral facilitator.) After students have explained their positions, ask the students if they would like to move their dots based on the various rationales they have heard. Discuss how ‘Actively Listening’ to other people’s perspectives can have an impact on one’s opinions; and that it is okay to change opinions as one learns more about issues. Also discuss the difference between opinions based on facts, and opinions based on emotion.

ALTERNATIVES to Pear Deck: (1) Use the same statements and provide chart paper or white board and give students actual dots (you will need to create 2 of each of the charts in advance to allow them to change the position of their dots after dialogue). (2) You can create a google doc in google drive and allow students to add colored marks/dots to the doc (any cloud-based word processing or notepad will work) and then after dialogue allow them to move those dots.

Explore

- Students are assigned to teams (5 students per team) *NOTE: The remaining lesson assumes five students per group – adjust as necessary for your student numbers.*
- Students in each team will read the newsletter, “The Anywhere News”, about the illness in Anywhere, SC (attached).
- Using information presented in the article, students begin brainstorming the cause/source of the illness and begin completing the attached Possible Causes student graphic organizer. Ensure students know that these are to be annotated throughout the lesson. *NOTE: The team’s graphic organizer (see is there to assure students come to consensus as a team - in the unit (not included here) teams would turn this in as part of their portfolio.*
- Students then read, “Overview of Water-related Diseases and Contaminants” (attached):
 - All read the first 2 paragraphs
 - Each team member reads one of the following sections & shares the MIP (*see Disciplinary Literacy Strategies above*):
 - Arsenic & Metals
 - Bacteria

- Parasites
- Virus
- Compounds & Nonmetals
- As a team, students discuss possible causes and come to consensus as a team, then they create a team graphic organizer and use the team version in the “Explain” part of the lesson, creating a whole class version. NOTE: *These 2 exercises allow students to practice coming to consensus – If needed use sentence stems (like the bounce cards – see Disciplinary Literacy Strategies above) to elicit civil dialogue.*

Explain Each team shares thoughts from their brainstorming session and their team’s version of the ‘Possible Causes’ graphic organizer to create a class version of the “Possible Causes” graphic organizer. (Note: This can be used in later lessons to drive testing, investigations, and/or solution-based experimentation.) Teams cite references to support their additions to the graphic organizer.

Some example questions to ask while brainstorming:

- What evidence was used from the article?
- What might be some assumptions?
- Are the statements opinion or facts (how do we know)?

Teams will use their graphic organizer to make a final determination.

Elaborate Student teams use the Anywhere Map (*attached*) to locate all affected areas, as well as the origin, of ground water contamination. They should graphically display how they think the contamination spread and make marks on the map where they have questions, concerns, or need more information.

Evaluate

- Have the whole class count off 1-6 (*Start over at 1, until all team members have a number – remember there are only 5 team members but there will be 6 new “Expert” groups– so there will be less than 5 in each group*). Each **number represents a group** that will read an information card, an article and discuss both.
- Team Members should move to their Expert Group, taking with them:
 - a writing utensil
 - a notebook or paper
 - their ‘Anywhere News’ and Map
 - and their Possible Causes graphic organizer.
- Each expert group is given an envelope with copies of the group’s article (*Articles for Groups 1 – 6 attached*) and the Group’s Information Card (*6 different information cards 1 for each group attached*).
- Students read the article as research, then dialogue in their groups to identify: (a) evidence or possible evidence sources, (b) next steps, and (c) what evidence is needed to support the information card. NOTE: *Doing some water quality testing with students prior to this portion of the lesson will create relevancy.*
 - Articles (attached) are given to each student in a group.
 - The Group Information Card is read out loud. The card for each group provides details to assist students in creating a frame of refence, and connections with the Anywhere ground water contamination scenario. *See attached Group Information Cards.*
 - Provide quiet time for individual reading and reflection (15 – 20 min)
 - Provide time for group dialogue and the development of supporting arguments (20 – 30 min) – Provide Bounce cards to promote productive dialogue. (*see disciplinary literacy strategies above*)

- At the end of the dialogue, students will review notes and determine what they will share with their team. (15 min)
- Students from Expert groups return to their original teams.
- Use the, “Causal Factors: Debate Walkthrough (Teachers Guide)”, to walk the students through arguing for their choice of causal factor for the ground water contamination In Anywhere.
 - At the indicated time, distribute a set of role cards (*attached*) to each team. You can either predetermine who gets what role, you can allow the students to choose rolls, or it can be random (students pull one from an envelope). NOTE: *Role #6 is not necessary to the dialogue, only use it IF needed, i.e., you have that one odd TEAM of 6 students.*
 - Allow students to read the role card
 - Have students introduce the role/person they will be playing to the group. They should only share the top line of the card with the team.
 - Continue with steps 6 & 7 of the walk-through guide, “Causal Factors: Debate Walkthrough (Teachers Guide)”
- Allow time for teams to put together their presentation. Provide them with logistical parameters, i.e., use of visual aids, allotted presentation time, all members must participate, etc ... (NOTE: *You might want to include these on the rubric you choose – 2 attached*).
- Teams present their causal factor with their supporting evidence. Other teams challenge with their evidence. The arguments should follow the golden rules for arguing (*see resources*).
- During presentations use a team rubric (*2 are attached*) to assess each team.
- After all team presentations, provide ‘peer rubrics’ (*attached*) to each student and have each evaluate their teammates.

Assessment Notes:

Alternatively, provide students with geological and/or topographical maps of the town. Have student teams complete a map that shows how and where the contamination occurred because of these (AND SKIP the debate if you need to save on time). Post them, gallery walk, and then have the class discussion on next steps.

Have students create the Group Cards – Team up with an ELA or SS teacher and develop some questions that would guide students in creating role cards for each community focus.

If you include this lesson, in a unit about water, ecology or other large concept, the notes and artifacts the students make would be great additions to a unit portfolio.

References:

“Trouble in Fruitville” SEPUP kit: <https://sepuplhs.org/middle/modules/groundwater/index.html>

The Keystone Science School: <https://keystonescienceschool.org/> (*The curriculum mentioned here is copyrighted material that is provided to teachers who complete the workshop*)

The Keystone Centers Framework for Environmental Studies:
<https://keystonescienceschool.org/data/documents/school/beyond-the-classroom/BTC-Curriculum-Framework-2019.pdf> (*An excellent guide for how to create engaging PBL environmental scenarios.*)

Project Wet “A Grave Mistake” - <https://portal.projectwet.org/activities/a-grave-mistake> (*The curriculum mentioned here is copyrighted material that is provided to teachers who complete the Project Wet workshop – you need a username and password to access it*)

Resources:

- What is Pear Deck, <https://www.youtube.com/watch?v=rj9Bs-FDaHs>
- How to Use Pear Deck:
 - Google - <https://www.youtube.com/watch?v=9PJgsa-fnmA>
 - Microsoft - <https://www.youtube.com/watch?v=C3niDiaAbVk>
- The Golden Rules of Argument-Centered Instruction: <https://argumentcenterededucation.com/2018/06/26/golden-rules-of-argument-centered-instruction/>
- Ground Water Detectives (an exploration lab from Teach Engineering): https://www.teachengineering.org/activities/view/cub_enveng_lesson04_activity2
- Oregon State University: Hydroville Curriculum Project: <http://blogs.oregonstate.edu/hydroville/>
- Ground Water Data from the USGS (US Geological Survey) - <https://www.usgs.gov/special-topic/water-science-school/science/groundwater>

Research for Students:

- Bloudoff-Indelicato, M. (October 30, 2015). Arsenic and Old Graves: Civil War-Era Cemeteries May Be Leaking Toxins, *Smithsonian*, (180957115). Retrieved from <https://www.smithsonianmag.com/science-nature/arsenic-and-old-graves-civil-war-era-cemeteries-may-be-leaking-toxins-180957115/>.
- Doršner, Kamala et al. (November 2019). Environmental Biology. [Digital PDF]. Retrieved from: <https://openoregon.pressbooks.pub/envirobiology/chapter/6-4-case-study-the-love-canal-disaster/>.

Teacher Biographical Information:

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OPINION STATEMENTS

A = agree

U = undecided

D = disagree

1. Cigarette smokers should not be allowed to smoke in any public place.

A U D

2. Bike riders should be required by law to wear a helmet.

A U D

3. Animals should not be used in medical research.

A U D

4. Supermarkets should stop providing grocery bags; shoppers should bring their own.

A U D

5. Recycling should be mandatory.

A U D

6. Dihydrogen Oxide should be banned in all public places.

A U D

(OVER for facts about dihydrogen oxide)

TOXIC PROPERTIES OF DIHYDROGEN OXIDE

- Causes excessive sweating and vomiting
- A major component of acid rain
- Can cause severe burns in the gaseous state
- Accidental inhalation can kill you
- Primary contributor to erosion
- Decreases effectiveness of automobile brakes
- Has been found in tumors of terminal cancer patients
- May dissolve metal ions especially in the presence of road salt
- Some scientists believe that in a vapor form, it is responsible for 95% of greenhouse gases

FYI: Dihydrogen Oxide = H_2O (water)- remove this if you provide the above to students



Anywhere, SC Chamber of Commerce
100 East Main Street
Anywhere, SC 55555



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The Anywhere News

200 SICK IN ANYWHERE SC

This small suburban town located in the foothills of SC made state news last week as the SC Department of Health and Environmental Control, DHEC, announced that 200 clinic cases might be associated with a ground water contamination.

The symptoms most patients reported were sweating, abdominal pain and fever with no indication of infection. "Poison was considered a possibility in several of the cases and they were treated with a general poison protocol" said a clinic employee. But the clinic confirmed that they did not isolate a causal agent.

On Friday, November 29, 2019, the SC branch of DHEC was brought in to help determine the cause of the 'poisonings'. DHEC spokesperson Emil Dodson announced on Monday that there were over 200 cases in the Anywhere community that are being attributed to ground water contamination. The contamination was identified on Friday when a man reporting the same symptoms came into the clinic with a sample of his well water that contained numerous contaminants. But scientists can not confirm the well as the cause.

The most recent outbreaks seems to have started several weeks ago. A group of scientists from the local and state universities have gathered in the rural town to discover the cause of the illness. So far the cases seem to be localized in the Anywhere town area.

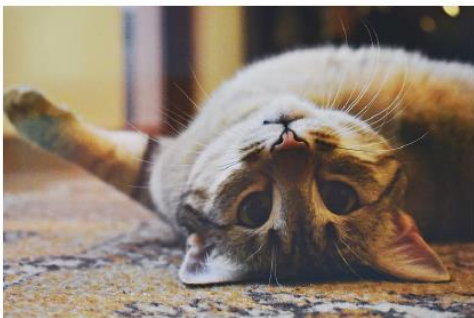


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CONTACT SC DEHEC IF YOU:

- Have fever, abdominal pain and sweating.
- Use well water for consumption.
- Notice abnormal animal behavior.
- Notice a strange film on puddles or exterior water sources.



Pets & Tricks

Fido's not the only one doing pet tricks, says veterinarian and Pet Chef, Sarah Cooksalot. She and her veterinary technician, Laura Bombdogner, have developed a 'homemade' pet recipe that is not only good for both dogs and cats, 100% of their test cases have loved it! Dr. Cooksalot says, "the recipe is the same for both animals with a small tweak for cats, less turmeric and an added supplement", which can be purchased directly from the office. The recipe will be available for free on their website. "Folks can also order it online and have it delivered weekly for a nominal fee", says Ms. Bombdogner, [see the coupon below](#).

When asked about the recent investigation into the city's outbreak, Dr. Cooksalot confirmed a number of her four-legged patients presented with dehydration and upset stomachs. She also reported that although this is common, the number of patients she has seen lately, has been unusually high. She did say, "all seemed to recover after spending a night or two in the hospital receiving fluids, antibiotics, and the new pet recipe".

IS Your Dogfood safe?

Not so many dogs are turning tricks in Anywhere SC, right now. The meat processing plant, Dixon's Allmeats, is under investigation after a man took cans of his dog's food to his vet's office on Sunday, after his dog, Sam, of 13 years, died. The Vet said Sam died from severe dehydration. Mr. Tom Smith, said he "didn't mean to cause a big fuss", he just wanted to know why his healthy hunting dog, "just up and got sick in the woods". At the behest of investigators, Dr. Cooksalot, had the cans sent off for testing. The investigators are not releasing the results of the tests at this time. The Vet also said that the dog could have survived, had he gotten to her earlier.

Mr. Smith had just setup camp for the night after a 3 mile hike, into the woods, hunting turkey. He said, Sam had just finished eating when he became violently ill. Mr. Smith carried Sam back to his truck, almost 3 miles, and call Dr. Cooksalot. She met them at her clinic around 4:30am. She suspected food poisoning and asked that Mr. Smith bring her Sam's canned food.

The dogfood comes from Dixon's Allmeats.

Sick continued

Local residents of this historical town think the illness may be caused by some type of food poisoning. The local watering hole, Southern Chick, famous locally, for its fried chicken is suspect. Its chickens come from Dixon's meat processing plant on the Northwest end of town. The plant is currently under investigation by health inspectors. Others believe pollution, from the old transportation maintenance warehouse, is the cause. Still others say the contamination is coming from the old mines or from improper waste disposal, from the 2 manufacturing plants (paper and coal power). There is even a neighborhood watch group on the west side that is blaming the waste in the dog park.

This once thriving gold and copper mining town is now a tourist destination for civil war enactments. It is home to several registered historical sites including a cemetery, battlefield, an antebellum home and the town hall (which served as a munitions facility during the war).

Tyler Crosshairs, the town's mayor says, "This is not an epidemic or a terrorist attack, it is likely the result of something local." rationalizing that "it has only effected a few of our local citizens". Furthermore, members, of the Anywhere Chamber of Commerce, invite visitors to attend the February reenactment of the "Battle For Anywhere's Well", held this week and weekend. They announcing that "all enactments are on schedule and all our restaurants and shops are open for business". "Our town is open to all your vacation needs", says the mayor who also said that they plan to monitor the problem closely.



Homemade Pet Food

10% Off

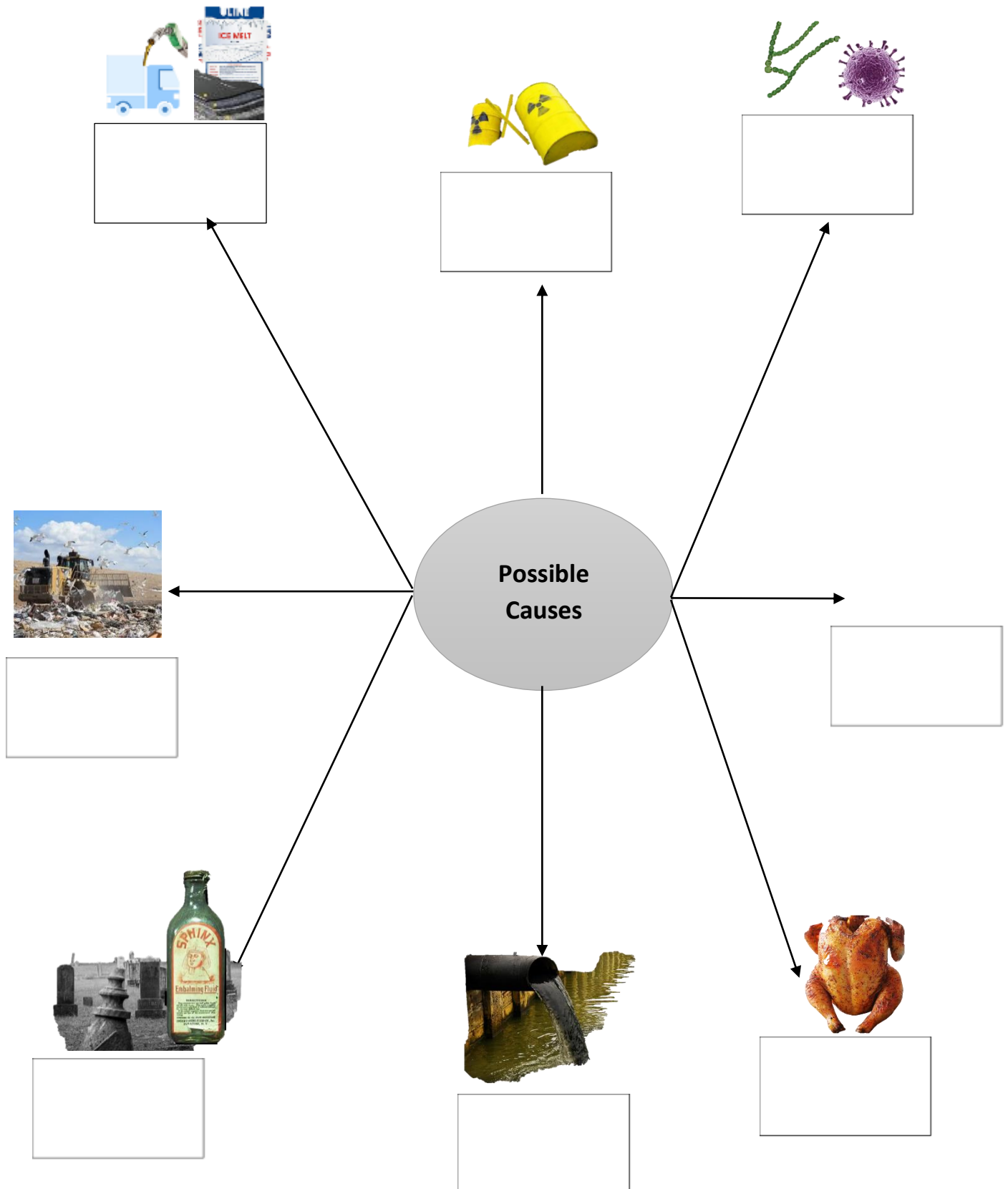
Cooksalot Veterinary Clinic 111 E. Main St Anywhere SC 55555

Your first order or delivery: www.cooksalotvet.org/petfooddelivery

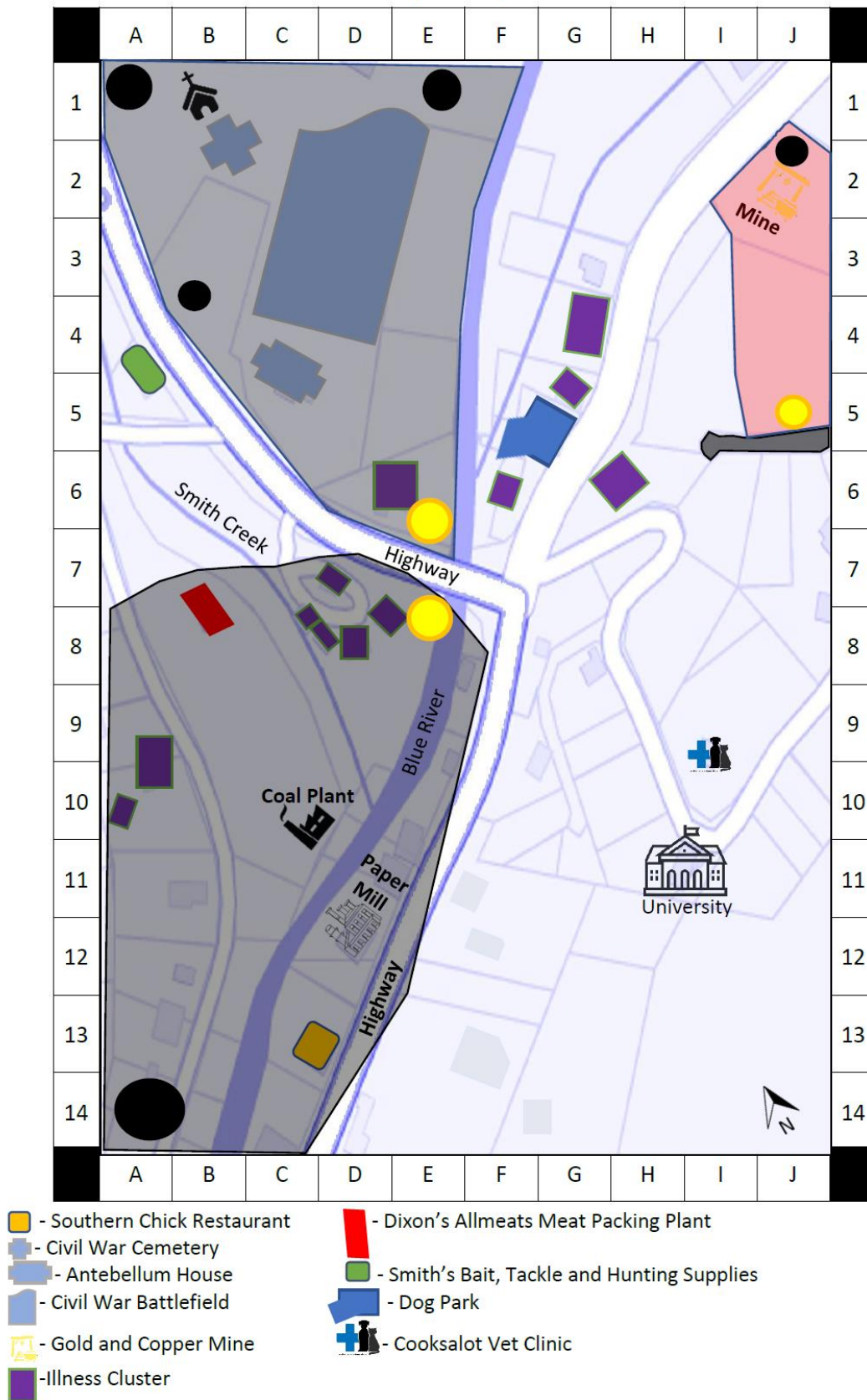
Office: 555.5555 Mobile: 777.7777

Expiration Date: 03/31/20

Possible Causes – Student Graphic Organizer



Town Map of Anywhere SC



The Shaded section, containing the graveyard and church, is on **a hill**. The A1 block is the highest point on the hill. The lowest point is block E6. Block E1 is higher than block B4. The gold/copper mine is on an **elevated cliff face** (shaded pink). The slope runs downhill from J2 in a straight decent to the bottom of J5. The shaded area in blocks I5 and J5 is a **deep ditch** that fills with water when it rains.

The Blue River flows NE. The Coal Plant and Paper Mill are on **a hill** in the shaded area. The highest point is at the South Western edge of town (A14, B14 and C14 Blocks). It is very steep under the highway in both directions (North and East). The creek that breaks off the river at F6, also flows NE right by the dog park.

High Hill Points are indicated by a **black circle**. Low Hill Points are indicated by a **yellow circle**. The largest black circle in the shaded area is the highest point. The largest yellow circle in the shaded area is the lowest point.

Overview of Water-related Diseases and Contaminants

Over 15 million U.S. households obtain their drinking water from private wells, which are not covered by the United States Environmental Protection Agency (EPA) regulations that protect public drinking water systems. Although the US has one of the safest drinking water supplies in the world, sources of drinking water can still become contaminated through naturally occurring chemicals and minerals (for example, arsenic, radon), local land use practices (for example, pesticides, chemicals, animal feeding operations), malfunctioning wastewater treatment systems (for example, sewer overflows), and other sources. Owners of private wells are responsible for ensuring that their water is safe from contaminants. Private wells should be checked every year.

The presence of contaminants in water can lead to health issues, including gastrointestinal illness, reproductive problems, and neurological disorders. Infants, young children, pregnant women, the elderly, and people whose immune systems are compromised because of AIDS, chemotherapy, or transplant medications, may be especially susceptible to illness from some contaminants.

Contaminants:

- **Arsenic** - Arsenic is an element that occurs naturally in rocks and soil and is used for a variety of purposes within industry and agriculture. It is a byproduct of copper smelting, mining, and coal burning. Arsenic can be used to preserve wood and to kill insects on cotton and other agricultural crops.
- **Metals – Copper** is a metal that occurs naturally in rock, soil, plants, animals, and water. Copper compounds are used as agricultural pesticides, in pipes and plumbing materials and to control algae in lakes and reservoirs. A trace amount of copper in our diet is necessary for good health. High levels of copper are not good and may get into the environment through mining, farming, manufacturing, and wastewater releases into rivers and lakes. **Lead** is a naturally occurring bluish-gray metal found in small amounts on the earth's outer layer. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.
- Bacteria contaminate water supplies through the feces of infected people or animals. Human or animal waste can enter the water through sewage overflows, sewage systems that are not working properly, polluted storm water runoff, and agricultural runoff. Wells may be more vulnerable to such contamination. **Salmonella** bacteria spread through human or animal feces and cause diarrhea. Campylobacteriosis (CAMP-eh-loe-back-tear-ee-O-sis) is an infectious disease caused by the bacteria **Campylobacter**. It is also the most common bacterial cause of diarrheal illness in the United States. **E. coli O157:H7** (Ee KOE-lye) is one of the hundreds of strains of the bacterium *Escherichia coli*. Most strains are harmless and live in the intestines of healthy humans and animals. However, this strain, O157:H7, produces a powerful toxin that can cause severe illness. The bacteria can be found on cattle farms and can live in the intestines of healthy cattle. **Shigella** is a group of bacteria causing the most contagious types of diarrhea. However, most outbreaks occur in recreational water, rather than in drinking water.
- Parasites infect water systems much the same way as bacteria (see above) - Giardiasis (GEE-are-DYE-uh-sis) is a diarrheal illness caused by a microscopic parasite, **Giardia intestinalis** (also known as *Giardia lamblia* or *Giardia duodenalis*). Once an animal or person is infected

with *Giardia*, the parasite lives in the intestine and is passed in feces. Because the parasite is protected by an outer shell, it can survive outside the body and in the environment for long periods of time (i.e., months). During the past 30 years, *Giardia* infection has become recognized as a common cause of waterborne disease in humans in the United States. Cryptosporidiosis ((krip-toh-spore-id-ee-OH-sis), is a diarrheal disease caused by a microscopic parasite, **Crypto** lives in the intestine of humans and animals and is passed in the stool of an infected person or animal.

- Virus infect water systems much the same way as bacteria (see above). **Enteroviruses** are a group of small viruses. There are two subgroups those that cause polio and those that cause non-polio-related diseases. The non-polio enteroviruses are second only to cold viruses as the most common cause of viral infections in humans. Enterovirus infections are most likely to occur during the summer and fall. They cause an estimated 10-15 million or more illnesses a year in the United States. **Hepatitis A** is a contagious liver disease that results from infection with the Hepatitis A virus. It can range in severity from a mild illness lasting a few weeks to a severe illness lasting several months. Hepatitis A is usually spread when a person ingests fecal matter – even in microscopic amounts – from contact with objects, food, or drinks contaminated by the feces, or stool, of an infected person. **Norovirus** is the official name for a group of viruses previously described as “Norwalk-like viruses” (NLV). Noroviruses cause intestinal illness, or gastroenteritis, and have been associated with outbreaks on cruise ships and in communities, restaurants, camps, schools, institutions, and families. **Rotaviruses** are wheel-shaped (“rota”) viruses that cause intestinal illnesses and are the most common cause of severe diarrhea among infants and children. They are *rarely* found in drinking water and are delivered through human feces.

Compounds and Nonmetals – **Nitrates** form when nitrogen combines with oxygen or ozone. Nitrogen is essential for all living things, but nitrates can be dangerous. Nitrates are also made in large amounts by plants and animals and are released in smoke and industrial or automotive exhaust. They are key ingredient in fertilizers and explosives. **PCBs (Polychlorinated Biphenols)** are a family of man-made chemicals, typically oily liquids, ranging from colorless to light yellow in color. They have no smell or taste and because they do not burn easily, are used to insulate electrical components like transformers. The manufacturing of PCBs was stopped in 1977 because of its environmental and health related issues. PCB’s are carried into water systems via flooding, leaks or dumping. They are found in the blood, fat and breast milk of humans and animals. **Radon** is a colorless, tasteless, odorless, radioactive gas. It occurs naturally and is produced by the breakdown of uranium in soil, rock, and water. It can also dissolve into our water supply. High levels of dissolved radon are found in the groundwater in some areas flowing through granite or granitic sand and gravel formations. Showering, washing dishes, and laundering can disturb the water and release radon gas into the air you breathe. Phosphorus occurs naturally in rocks and other mineral deposits.

Information in this article retrieved from the CDC (Centers for Disease Control). More information can be found at <https://www.cdc.gov/healthywater/diseases.html>.

Group 1 Information Card

The best way to determine arsenic contamination of ground water is to take samples from wells in a grid and plot the results on a map. Use your map to plot the following well data. Determine, based on your article, IF... there is arsenic contamination, and from where it is leaking. *Make sure to document all your evidence from the article, the data, and the map.

Well Grid	Arsenic (ppb)	Well Grid	Arsenic (ppb)	Well Grid	Arsenic (ppb)	Well Grid	Arsenic (ppb)	Well Grid	Arsenic (ppb)
A1	0	D1	0	F3	29	H8	11	J4	35
A4	12	C4	40	D7	33	H9	15	A14	0
A9	22.5	E6	58	D13	0	I10	0	J13	0
A10	22	F6	55	D10	39	I11	0	G12	16

Arsenic and Old Graves: Civil War-Era Cemeteries May Be Leaking Toxins (Group 1)

This poisonous element, once used in embalming fluids, *could* be contaminating drinking water as corpses rot.

By Mollie Bloudoff-Indelicato

SMITHSONIANMAG.COM

OCTOBER 30, 2015

If you live near a Civil War-era cemetery, rotting corpses may be on the attack! While there's no need to fear the walking dead, homeowners should watch out for toxins leaking from old graves that could be contaminating drinking water and causing serious health problems.

When someone died at the turn of the century, it was common practice to bring a photographer in to take death photos. Also, the people who fought and died in the Civil War came from all over the United States, and families who wanted to bury their kin would pay to have them shipped home.

At the time, ice was the only option to preserve a body, but that didn't work very well—and no one wants to see a deceased relative partially decomposed.

"We're talking about the 1800s, so how do you freeze [the bodies] and keep them frozen if they take weeks to transport?" says Jana Olivier, an environmental scientist and professor-emeritus at the University of South Africa.

Thus, embalming in the U.S. became a booming industry during the Civil War era. People willing to try their hand at embalming, spent their time following the military from combat zone to combat zone.

"Embalmers flocked to battlefields to embalm whoever could afford it and send them home," said Mike Mathews, a mortuary scientist at the University of Minnesota.

Embalming fluid is effective, but it's also nasty stuff. Many early recipes for embalming fluid were jealously guarded by morticians because some worked so much better than others, but commonly contained arsenic, Mathews adds.

One popular formula "contained about four ounces of arsenious acid per gallon of water, and up to 12 pounds of non-degradable arsenic was sometimes used per body," according to the 5th Street Cemetery Necrogeological Study.

Arsenic kills the bacteria that make corpses stinky—if you've ever smelled bad meat, you can imagine how important it is for embalming fluid to do its thing and do it well. Unfortunately, the poisonous element doesn't degrade, so when embalmed bodies rot in the ground, arsenic gets deposited into the soil.

"A Civil War-era cemetery filled with plenty of graves—things seldom stay where you want them to," says Benjamin Bostick, a geochemist at Columbia University. "As the body is becoming soil, the arsenic is being added to the soil." From there, rainwater and flooding can wash arsenic into the water table.

That means old cemeteries full of deceased soldiers and civilians present a real problem for today's homeowners. The federal government says it's only safe for us to drink water with 10 parts per billion of arsenic or less. But in 2002, a USGS-sponsored survey in Iowa City found arsenic levels at three times the federal limit near an old cemetery.

"When you have this big mass of arsenic, there's enough to affect literally millions of liters of water at least a little bit," Bostick says.



Soldiers bury Union dead who fell near Fredericksburg, Virginia, during the 1863 Chancellorsville Campaign. (Medford Historical Society Collection/CORBIS)

If humans ingest the contaminated water, it can cause significant health problems *over time*. Arsenic is a carcinogen that's associated with skin, lung, bladder and liver cancers, says Joseph Graziano, an environmental health scientist at Columbia University. Drinking arsenic-contaminated water has also been linked to cardiovascular disease, lung disease and cognitive deficits in children.

The good news is that arsenic was banned from embalming fluid in the early 1900s. It was causing health problems for medical students who were operating on embalmed cadavers. Also, the presence of so much arsenic made murder investigations almost impossible. Police could not distinguish between embalming fluid arsenic and cases of murder by arsenic poisoning.

"The state stepped in and said [morticians] couldn't use arsenic anymore. Boy, they outlawed it really quick," Mathews says. Now, morticians use a combination of glutaraldehyde and formaldehyde—both chemicals that sterilize—to embalm bodies for open caskets, he adds. These chemicals evaporate away before they pose a risk to the water table.

But if you live near an old cemetery, you should get your well water checked for arsenic and other contaminants every few years, Mathews advises. The accepted level of arsenic in drinking water is 50 parts per billion (ppb).

"Sadly, much of the population today isn't aware of the hazard that arsenic poses," Graziano says. "Any homeowner should be testing their well water frequently. We need to be vigilant about hazards from drinking water."

Group 2 Information Card

About 100 million kg of toxic pollutants are released every year from the paper industry. Volatile organic compounds (VOCs) are compounds that easily become vapors or gases. VOCs are released from several of the methods used to pulp paper. The U.S. EPA regulates VOCs at Federal level in 40 CFR 59, which is the National Volatile Organic Compound Emission Standards for Consumer and Commercial Products. The paper pulping portion of the plant in Anywhere has been higher than the standard on two occasions in the past five years. The EPA has issued a warning, but no fines have been levied.

Coal combustion wastes contain a variety of toxic compounds such as arsenic, cadmium, chromium, cobalt, lead, mercury, selenium, thorium and uranium, as well as dioxins and poly-aromatic hydrocarbons (PAHs). Despite the presence of these toxic compounds, this waste has not been regulated by the EPA as hazardous waste. Residents living near an unlined coal waste pond can have a '1 in 50' chance of getting cancer from the site-primarily through exposure to arsenic. Check with group one and ask for a copy of their data.



Figure 1. Love Canal. Source: US Environmental Protection Agency

6.5 Case Study: The Love Canal Disaster (GROUP 2)

One of the most famous and important examples of groundwater pollution in the U.S. is the **Love Canal tragedy** in Niagara Falls, New York. It is important because the pollution disaster at Love Canal, along with similar pollution calamities at that time (Times Beach, Missouri and Valley of Drums, Kentucky), helped to create **Superfund**, a federal program instituted in 1980 and designed to identify and clean up the worst of the hazardous chemical waste sites in the U.S.

Love Canal is a neighborhood in Niagara Falls named after a large ditch (approximately 15 m wide, 3–12 m deep, and 1600 m long) that was dug in the 1890s for hydroelectric power. The ditch was abandoned before it actually generated any power and went mostly unused for decades, except for swimming by local residents. In the 1920s Niagara Falls began dumping urban waste into Love Canal, and in the 1940s the U.S. Army dumped waste from

World War II there, including waste from the frantic effort to build a nuclear bomb. Hooker Chemical purchased the land in 1942 and lined it with clay. Then, the company put into Love Canal an estimated 21,000 tons of hazardous chemical waste, including the carcinogens benzene, dioxin, and PCBs in large metal barrels and covered them with more clay. In 1953, Hooker sold the land to the Niagara Falls school board for \$1 and included a clause in the sales contract that both described the land use (filled with chemical waste), and absolved them from any future damage claims from the buried waste. The school board promptly built a public school on the site and sold the surrounding land for a housing project that built 200 or so homes along the canal banks and another 1,000 in the neighborhood (Figure 1). During construction, the canal's clay cap and walls were breached, damaging some of the metal barrels.

Eventually, the chemical waste seeped into people's basements, and the metal barrels worked their way to the surface. Trees and gardens began to die; bicycle tires and the rubber soles of children's shoes disintegrated in noxious puddles. From the 1950s to the late 1970s, residents repeatedly complained of strange odors and substances that surfaced in their yards. City officials investigated the area but did not act to solve the problem. Local residents allegedly experienced major health problems including high rates of miscarriages, birth defects, and chromosome damage, but studies by the New York State Health Department disputed that. Finally, in 1978 President Carter declared a state of emergency at Love Canal, making it the first human-caused environmental problem to be designated that way. The Love Canal incident

became a symbol of improperly stored chemical waste. Clean up of Love Canal, which was funded by Superfund and completely finished in 2004, involved removing contaminated soil, installing drainage pipes to capture contaminated groundwater for treatment, and covering it with clay and plastic. In 1995, Occidental Chemical (the modern name for Hooker Chemical) paid \$102 million to Superfund for cleanup and \$27 million to Federal Emergency Management Association for the relocation of more than 1,000 families. New York State paid \$98 million to EPA and the US government paid \$8 million for pollution by the Army. The total clean-up cost was estimated to be \$275 million.

The Love Canal tragedy helped to create Superfund, which has analyzed tens of thousands of hazardous waste sites in the U.S. and cleaned up hundreds of the worst ones. Nevertheless, over 1,000 major hazardous waste sites with a significant risk to human health or the environment are still in the process of being cleaned.

Attribution

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Group 3 Information Card

Dixon's Allmeats Meat Processing Plant is under investigation for illegally dumping their wastewater directly into the city's sewage line. Prior to the investigation there have been allegations of improper procedures used in cleaning the facility. The Anytown Water Works began an investigation last month and discovered that the company had re-routed their drain lines directly into the city's sewage lines bypassing the wastewater treatment

The EPA was tipped off, and they began testing the ground water near the facility and found higher than normal concentrations of E.Coli, but at a level that was illegal. They also found high amounts of animal fats and blood- although those are not illegal.

In the past year, the summer algal blooms in the ponds near the meat processing plant have been so high that local fisherman don't fish them anymore. Why? Because there are no fish in them.

Additionally, Southern Chick gets its chickens from Dixon's.

From the US Department of Justice Website specifically copied from: <https://www.justice.gov/opa/pr/north-carolina-poultry-processing-plant-and-manager-indicted-violations-clean-water-act>

Department of Justice (Group 3)

Office of Public Affairs

FOR IMMEDIATE RELEASE

Monday, November 30, 2009

North Carolina Poultry Processing Plant and Manager Indicted for Violations of Clean Water Act

WASHINGTON—A federal grand jury in Greensboro, N.C., returned an indictment today charging a poultry processor and a plant manager with multiple violations of the Clean Water Act for illegally discharging wastewater from its Raeford, N.C., based facility, the Justice Department announced.

House of Raeford Farms Inc. and its plant manager, Gregory Steenblock, were both charged with 14 counts of violating the Clean Water Act. House of Raeford is a turkey slaughter and processing facility located in Raeford.

The indictment alleges that on 14 occasions between January 2005 and August 2006, House of Raeford and plant manager Steenblock, allowed plant employees to bypass the facility's pretreatment system and send its untreated wastewater directly to the Raeford Publicly Owned Treatment Works without notifying city officials. The untreated wastewater was contaminated with waste from processing operations, including blood and body parts from the slaughtered turkeys.

The bypasses and failure to report them were in violation of House of Raeford's pretreatment permit, as well as the city of Raeford's sewer use ordinance. As alleged in the indictment, many of the bypasses took place while House of Raeford was subject to a consent order with the city that specifically required it to eliminate all bypasses from its facility.

House of Raeford is owned by House of Raeford Farms Inc., a privately held corporation operating seven poultry slaughter and processing facilities in North Carolina, South Carolina and Louisiana. The Raeford facility processes over 30,000 turkeys per day and its operations generate approximately one million gallons of wastewater per day.

An indictment is merely an accusation, and a defendant is presumed innocent unless and until proven guilty in a court of law.

If convicted, the company faces a maximum fine of \$500,000.00 or twice the gain or loss resulting from the offense, whichever is greater, per count. Steenblock faces a maximum penalty of five years in prison and a \$250,000.00 fine, per count.

The case is being prosecuted by the Justice Department's Environmental Crimes Section and was investigated by U.S. Environmental Protection Agency-Criminal Investigation Division and North Carolina State Bureau of Investigation.

Component(s):

[Environment and Natural Resources Division](#)

Press Release Number:

09-1288

Updated September 15, 2014

From the US Department of Justice Website specifically copied from: <https://www.justice.gov/opa/pr/north-carolina-poultry-processing-plant-and-manager-indicted-violations-clean-water-act>

EPA sued for allowing slaughterhouses to pollute waterways

EPA last revised pollution standards for thousands of meat-processing plants 15 years ago and some guidance dates back to 70s. (Group 3)

[Nina Lakhani](#) in New York

Wed 18 Dec 2019 13.58 EST Last modified on Wed 18 Dec 2019 15.27 EST



Around 4,700 slaughterhouses discharge polluted water into waterways including the Chesapeake Bay, the country's largest estuary.

A coalition of conservation and community groups representing millions of people is suing the Environmental Protection Agency (EPA) for refusing to update national water pollution standards for slaughterhouses.

The EPA decision allows thousands of meat

and poultry processing plants to continue using outdated pollution-control technology, which has been linked to the contamination of waterways across the US.

More than eight billion chickens, 100 million pigs, and 30 million cattle are processed each year in more than 5,000 slaughterhouses in America. Around 4,700 of these slaughterhouses discharge polluted water into waterways, including the Chesapeake Bay, the country's largest estuary.

"[Current] EPA standards are either weak and outdated or nonexistent," said Sylvia Lam, a lawyer with the not-for-profit Environmental Integrity Project, which filed the lawsuit on Wednesday.

"Cleaner plants have already installed technology to lessen the pollution they send into their local rivers and streams. By not updating these nationwide standards, EPA is rewarding dirty slaughterhouses at the expense of the public."

The Clean Water Act requires the EPA to set industry-wide water pollution standards for slaughterhouses and to review those standards each year to decide whether updates are necessary in order to keep pace with advances in pollution-control technology.

In October 2019, the EPA announced it would not revise the federal water pollution standards for slaughterhouses that directly discharge processed wastewater into waterways. The EPA last revised these standards 15 years ago and more than a third of these slaughterhouses operate under guidelines that date back to the 1970s. The agency also declined to create standards for plants that indirectly pollute waterways, such as by sending wastewater to sewage plants before it is discharged into rivers or streams.

“EPA’s failure to update pollution standards for slaughterhouses is illegal – and it allows a major industry to continue cutting corners at the expense of communities and the environment,” said Alexis Andiman, a lawyer with Earthjustice.

Slaughterhouses discharge wastewater contaminated with blood, oil and grease, and fats, which contains nitrogen and phosphorus pollution – pathogens – among other contaminants. This can cause algal blooms that suffocate aquatic life and turn rivers and streams into bacteria-infected public health hazards.

America’s largest slaughterhouses are clustered in rural parts of North Carolina, Arkansas, Delaware, Georgia, Illinois, Indiana, Iowa, Mississippi and Pennsylvania. A large proportion are owned by large corporations, with the 100 top companies each reporting to have received between \$83m and \$40bn in revenues in 2019.

In an October 2018 report, the Environmental Integrity Project (EIP), found the average slaughterhouse discharged over 330lbs of nitrogen a day in 2017 – the amount of pollution in untreated sewage from a town of 14,000 people. At least 66 of the 98 plants surveyed by EIP were owned by companies with more than \$2bn in annual revenues.

“Some of the world’s largest meat companies are dumping huge volumes of pollution into America’s rivers – pollution that contributes to toxic algae and puts our drinking water at risk. Surely, it is not too much to ask that those who produce our food to stop polluting our water,” said John Rumpler from Environment America, one of the plaintiffs. The Environmental Integrity Project (EIP) and Earthjustice, filed the lawsuit in the court of appeals for the fourth circuit in Richmond on behalf of Cape Fear River Watch, Rural Empowerment Association for Community Help, Waterkeepers Chesapeake, Animal Legal Defense Fund, Center for Biological Diversity, Comité Civico del Valle, Environment America, Food & Water Watch, The Humane Society and Waterkeeper Alliance.

“EPA has the authority and responsibility to stop slaughterhouses from polluting our water,” said Devon Hall, the co-founder of the Rural Empowerment Association for Community Help in North Carolina. “If EPA doesn’t do its job, who will?”

An EPA spokesperson said the agency does not comment on pending litigation.

Group 4 Information Card

The Mine and Transportation Warehouse are at the highest elevation in Anywhere. An underground stream from the Blue River runs under ‘Southern Chick’ and then goes deep into the Earth. It comes close to the surface near the transportation warehouse and runs toward the Mine. Geological evidence suggests that one of the towns largest aquifers is located under the Transportation Warehouse and its lot.

The transportation warehouse was used to store the equipment, materials and chemicals used to repair roadways. There are still several full asphalt tanks in there. However, since the DOT moved their base of operations to the neighboring town, the surrounding area’s volunteer fire departments are storing their fire foam in part of the warehouse. They are paying the state’s DOT and the town of Anywhere a small fee to rent the storage space. There is no official monitoring of the warehouse.

The Post and Courier

The Air Force polluted 4 SC bases with a toxic firefighting foam, didn't tell neighbors (Group 4)

[By Andrew Whitaker awhitaker@postandcourier.com](mailto:awhitaker@postandcourier.com)

Jul 13, 2019



The Shaw Air Force Base water tower is seen on base on Monday, July 1, 2019 in Sumter County. Andrew J. Whitaker/Staff

Federal reports found hazardous chemicals known as PER - and polyfluoroalkyl substances in groundwater under Air Force bases in South Carolina. "I hope it don't get anybody sick."

Four Air Force bases in South Carolina are severely contaminated with chemicals that scientists continue to investigate for possible links to thyroid disease, pregnancy complications, kidney and testicular cancers.

The man-made chemicals are from an industrial foam the military used to extinguish fires at bases since 1970 — a toxic

legacy that has only recently come to light. Three studies obtained by The Post and Courier show Shaw Air Force Base, Joint Base Charleston, the North Auxiliary Airfield and the former Myrtle Beach Air Force Base are all saturated with the compounds — known as PFOS and PFOA. Some of the groundwater collected from the four sites contained chemical levels thousands of times higher than an advised limit laid out by the U.S. Environmental Protection Agency (EPA).

At Shaw AF Base, in Sumter County, the study suggested the chemicals could leach into wells that provide drinking water to several nearby trailer parks. "The groundwater in the area presents a potential hazard to human health," warned the report commissioned by the Air Force. "Drinking water may be impacted."

South Carolina isn't the only state where these contaminants have raised serious concerns. The Department of Defense found similar pollution in at least 27 other states, including Florida, Georgia and Virginia. And the list continues to grow. Defense Department officials reported last year that nearly 400 Army, Navy, Marine Corps and Air Force bases could be contaminated around the globe. And they noted that roughly 600 drinking water systems on or near military bases have already tested positive for significant levels of the pollutants.

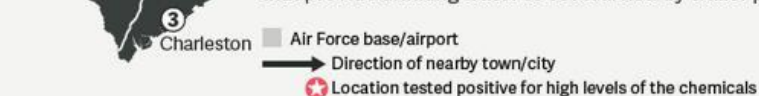
For decades, the chemicals were valued for their unique properties. They create nonstick surfaces. They also are water and grease resistant. That's why they were used to manufacture Teflon cookware, GoreTex clothing, stain-resistant carpets and the firefighting foam that was stockpiled by the military.

The Air Force regularly used the foam during training exercises and aviation accidents. The product is now being phased out by the military, but that hasn't stopped federal

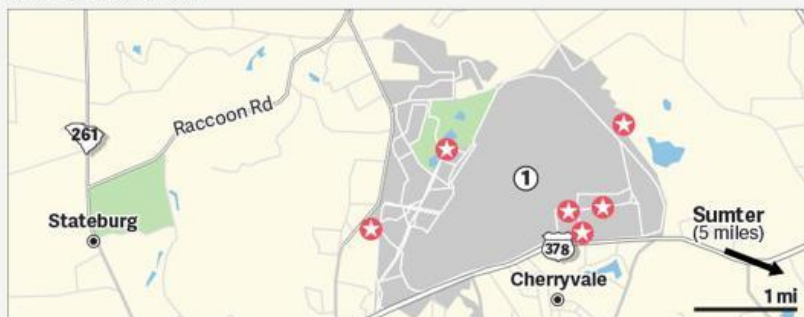
lawsuits from popping up all over the country. “This is a nationwide public health issue that is not being treated like one,” said Genna Reed, a policy analyst with the Union of Concerned Scientists who has followed the growing number of bases that have tested positive for the chemicals. “This is a problem that demands a concerted, urgent, federal, effort to stop the contamination where it is and to notify communities who live nearby,” she said. Most of the environmental studies in South Carolina were completed over the past year. ALL studies were shared with the S.C. Department of Health and Environmental Control.

Groundwater contaminated by chemicals

Three previously undisclosed studies obtained by the Post and Courier show Shaw Air Force Base, Joint Base Charleston, the former Myrtle Beach Air Force Base and the North Auxiliary Airfield in Orangeburg County are all saturated with industrial chemicals. The man-made compounds are from a firefighting foam the military showered onto airfields over several decades. At Shaw, the study warned the chemicals could leach into wells that provide drinking water to several nearby trailer parks.



Shaw Air Force Base



Former Myrtle Beach Air Force Base



Joint Base Charleston



North Auxiliary Airfield



SOURCE: ESRI

Unfortunately, all were not advised of the studies or results.

The people who live at the Crescent Motor Home Park are intimately familiar with the rhythms and routines of Shaw Air Force Base.

The small community is less than a mile from the runway where F-16 fighter jets roar into the sky.

Residents who pay for an open lot or lease an available trailer can see the fence line for the military installation just across S.C. Highway 378.

Yet none of the families, retirees, or military veterans who call the trailer court ‘home’, were aware the Air Force found potentially hazardous chemicals less than a mile away from their drinking water. The environmental study at Shaw was finished in January. But over the

past six months no public notices were issued. No community meetings were held. Neither the Air Force nor the state health department tested the tap water at the communities that surround the base.

“Why don’t they come and test this water?”, asked Grant Head, a Navy veteran who has lived at the Crescent Motor Home Park for the past four years. New lab results show the tap water in the community contains man-made chemicals known as perfluoroalkyl and polyfluoroalkyl substances — PFAS for short. During the study, groundwater samples were collected from six locations around Shaw. All six tested positive for the chemicals.

Group 5 Information Card

The Mine and Transportation Warehouse are at the highest elevation in Anywhere. An underground stream from the Blue River runs under ‘Southern Chick’ and then goes deep into the Earth. It comes close to the surface near the transportation warehouse and runs toward the Mine. There are parts of the mine that flood when it rains a lot. At one of the deepest parts, the miners hit the stream, and had to reroute the water. There are now several reservoirs down in the lower portion of the mine.

Several hunters have reported seeing dead animals near the mine and near some of the smaller creeks and streams that run beside it. Mostly birds and rodents, a few coyotes, and one deer have been reported to the gaming warden, Oliver Totes.

The Tomato farm south west of the mine complained to the city last year-presenting data to the town council twice, that its soil was being acidified by the mine’s runoff. The data they collected demonstrated that the acidity level of the soil increased after a hard rain. Last year the farm created a culvert to divert the runoff away from the farm (it runs back toward the river).

**Residents discuss fears of mine contamination in rural York County (GROUP 5)**BY SAMMY FRETWELL - SFRETWELL@THESTATE.COM

OCTOBER 21, 2014 08:55 PM

When miners began digging out a small mountain near Clover in 1947, few people around here realized the legacy the developing business would leave on their community in rural York County.

Now, 67 years later, the federal government is trying to protect private wells from a plume of contaminated groundwater that leaked from the long-closed Henry's Knob kyanite mine. Groundwater has registered elevated levels of manganese and cobalt as a result of acid-draining rock, a problem of concern nationally at coal and metals mines.

During a meeting to discuss the mess Tuesday night, the effect that acid mine drainage has on communities was evident by the voices of frustrated people living near the Henry's Knob mine, off S.C. 55.

Many complained that the government hasn't done enough to protect their well water and it has failed to inform them about cleanup efforts. Others said the cloud created by pollution from the mine has affected their health, made it impossible to grow grass in their yards, and made it difficult to sell or refinance their homes.

"We want respect," Georgia Linkous-Long told federal regulators. "We're tired of being sick. We're tired of not having a water source."

Terry Wilson, who also lives near the old mine, said contamination from the mine prevented him from refinancing his house. The banks he approached would not grant a new loan at a lower interest rate because of the pollution, he said.

Greg Winn said the S.C. Department of Health and Environmental Control has known about the problem since at least 1998, two years after he moved to the area. Neither DHEC nor the U.S. Environmental Protection Agency has resolved the problem since then, he said. The EPA got involved at Henry's Knob about 10 years ago, through the agency's Superfund cleanup program.

"Many years ago, this should have been fixed," Winn said as he left the meeting. "My big problem, and it happens so often with government organizations, is everything just gets drug out. We only get little bits and pieces of information here and there."

Kyanite is a mineral used in porcelain and ceramic materials, such as spark plugs and tiles. It is sought after because it can withstand high temperatures. Similarly to gold and copper mines, it can also create acid drainage.

The saga at Henry's Knob, which may be the longest documented example of acid drainage in South Carolina, should come as no surprise to those familiar with mining. Acid-draining rock is what some experts consider the greatest environmental threat from open pit mines, because it can last for hundreds of years. Acid mine drainage can release metals and other materials that pollute groundwater and streams.

Open pit gold and copper mines from Montana to South Carolina are among those that have created acid drainage, sometimes leaving taxpayers on the hook for cleanup costs. Two closed gold mines in South Carolina are among them. Meanwhile, the largest gold mine ever planned for South Carolina, a

2,612-acre operation in nearby Lancaster County, has rock that could create acid drainage if miners are not careful.

Tuesday night's meeting, held by the EPA at a community school, was intended to let the public know about the agency's plan to protect well water for as many as 33 homes surrounding the Henry's Knob mine. The plan places \$20,000 water filters on private wells to weed out contaminants that threaten drinking water. An international company that owns part of the property is paying for the work.

At least four wells are polluted above safe drinking water limits, while others are threatened by the acid drainage, according to the EPA. In 2007, the EPA recommended that some of the homes switch to bottled water after the agency documented potential health threats from groundwater.

Craig Zeller, who is coordinating the cleanup for the EPA, said there's no way to know how long the acid drainage has occurred at Henry's Knob, but he estimated that the phenomenon could date back to when the mine closed some four decades ago. It isn't unusual for acid drainage to occur for generations, experts say.

"They stopped mining in '70, so at that point in time, it would have had acid mine drainage", Zeller said. "As soon as we realized it, there were about a half dozen folks put on bottled water."

The property has a complicated history. At one point after mining stopped, it was owned by a local government that then sold the land. It is now owned privately. Government regulators say they didn't know much about the problem until about 15 years ago.

Henry's Knob, a 185-acre site, includes a mining pit so full of acidic water that fish can't live there. The water also could be toxic to birds that land on its surface. The biggest sources of contamination are 'tailings' waste areas. Once watery ponds of toxic mine leftovers, the tailings areas are today filled with contaminated, sand-like material, that gives the appearance of the desert southwest, instead of the soggy southeast.

While on a visit to the site before Tuesday's meeting, Zeller pointed out the brilliant white mining waste surrounded by the natural red clay of the South Carolina foothills. A sulfur smell rose from the tailings waste, which is 80 feet thick in places, and fills an old creek bed. Only a few pine trees grew in the sandy material. The waste is too acidic for other plants to grow there.

"This is classic acid mine drainage," he said, explaining that the EPA is working to dig up and replant the area as an attempt to limit the drainage.

Whether miners dig for gold or kyanite- like that unearthed at Henry's Knob, the exposure of sulfide-rich rock to air and water can release acid. When long-buried rock is exposed to the elements, it creates sulfuric acid that can drain into creeks and groundwater, bringing elevated levels of toxic metals.

At Henry's Knob, about a dozen toxic materials have been found at elevated levels in groundwater, surface water and soil; but the pollutants of greatest concern are manganese and cobalt. They are not considered as toxic as some other substances, such as lead or mercury, but elevated concentrations in drinking water over a long period of time also are a potential health issue.

Manganese, a naturally occurring metal found in rocks, is of a particular concern for children who drink water with elevated levels. It is believed to affect neurological development. Cobalt, also naturally occurring, has been shown to cause death in adults and in children who consumed high levels. Beer makers in Canada and the U.S. discontinued the use of cobalt as a foam stabilizer in the 1960s, according to the federal Agency for Toxic Substances and Disease Registry.

Group 6 Information Card

The creek that runs by the dog park is one of the water offshoots from the Blue River. Several offshoots feed the wells on the North Eastern side of town- including the farm where most of the residents and restaurants get their produce.

The citizens in the Northeast neighborhood, Dogwood Estates, have been complaining about the dog park. They say that although patrons are supposed to pick up the dog poop, most do not. Further, they filed a formal complaint with the city. The complaint not only provides proof that patrons are not held accountable for picking up their dog's waste, but that the city's Parks and Recreation Department 'hose the poop off' into the Dogwood Creek. A video and some pictures were presented as evidence at the town hall meeting.

A major point of concern is; Southern Chick gets its produce from these farms.

Popular Science - <https://www.popsci.com/story/health/romaine-lettuce-recall-ecoli/>
HEALTH:

Why romaine lettuce keeps getting recalled (Group 6)

An investigation into the leafy green's dirty reputation.

By Molly Glick

January 9, 2020



Foodborne illness outbreaks from fresh produce have increased globally in recent years.

Once a kitchen staple, the ubiquitous romaine lettuce now often conjures fear and disgust. Since 2017, contaminated romaine has sparked four major E. coli outbreaks throughout the US. Last month, the CDC reported 138 people in 25 states infected with romaine-triggered E. coli bacteria.

If you're considering switching to kale, think again: Romaine likely isn't any riskier than other leafy greens. Spinach and other lettuce varieties are similarly vulnerable to a harmful E. coli strain, says Purdue University food science professor Amanda J. Deering. The reason romaine has been plagued by E. Coli more than other greens has more to do with its popularity. The more romaine, the more infections.

If you feel like romaine recalls have escalated, you aren't wrong. Food-borne-illness outbreaks from fresh produce have increased globally in recent years. Katzowitz says

this is likely due to increased fresh produce consumption, shifts in food production and distribution, and improved illness detection by public health officials.

Compared to other vegetables, though, our favorite salad bases are by far the most at risk for harboring dangerous bacteria. Unlike fruits and vegetables which grow higher above the ground or are protected by an outer shell or rind, leafy greens grow near the ground in open fields and are therefore susceptible to the germs from soil, water, and animal intestines, says CDC Health Communication Specialist Brian Katzowitz.

Unlike the E. coli strains that benefit your gut health, the O157:H7 strain is a known foodborne pathogen that commonly causes national outbreaks. When romaine makes with O157, it passes infection to humans and animals. Ultimately, the strain's origins can be difficult to track.

When an outbreak occurs, scientists view irrigation water sourced from dirty canals as a prime suspect. A November 2018, FDA report on the Yuma County, Arizona outbreak, isolated the offending O157:H7 E.-coli in an irrigation canal. How and when the bacterial strain entered the canal, however, is unknown.

Irrigation systems are also not the only link in the supply chain where contamination can occur. Even though the processing facilities sanitize romaine before chopping it, introducing a few infected plants can contaminate hundreds of pre-cut salad bags headed for grocery stores. This complicates FDA investigations.

"Sometimes you're looking for a needle in a haystack," Deering says. "It's very hard to be sure where it's coming from."

Once it reaches the plate, the O157 knows no boundaries; though young children and seniors are most vulnerable, the strain can infect people across ages. Symptoms of infection include diarrhea, nausea, fever, and vomiting. Those afflicted may even develop chronic kidney disease, high blood pressure, and kidney failure, according to the FDA.

Thankfully, new technology has aided the war against disease-spreading bacteria. Genome sequencing allowed researchers to trace back the O157 strains in the November 2018 romaine-based outbreak, Deering says. Plus, the 2011 Food Safety Modernization Act is considered a major win for food regulation. As an effort to thwart foodborne illnesses, it will set uniform safety standards for water, soil, and produce within most U.S. farms by 2024. The Act's Food Safety Plan focuses on preventive actions like identifying potential biological hazards.

During the next outbreak, check your romaine's origin to avoid any contaminated lettuce. Though salad-eaters should tread cautiously, they needn't abandon the infamous greens.

Role Card 1: Mayor of Anywhere – Tyler Crosshairs

You will facilitate for your group (keep track of time, tasks and majority ideas). During the discussion try and give everyone a chance to speak and keep people from speaking for too long.

Your greatest concern is that this contamination will hurt the economy of the town, by preventing tourists from visiting. Bad press would be harmful this week because the civil war re-enactment is one of the biggest economic boosts the town gets all year. You just want everyone to be reasonable and not jump to conclusions until all the facts are discovered.

Your questions for the group should be focused on evidence that supports your concerns. You should also, talk to any council members, as they will vote on a town plan- and to citizens, as they will either reelect you or not.

Role Card 2: Town Council Member and Business Owner – R. Dixon - Dixon's Allmeats Meat Packing Company

As a Town Council Member, you vote on all town plans and you are also looked to for advice and behavior. Assist in keeping the group talking. one at a time. and actively listening. You can demonstrate this for the group by using your bounce card when you participate in the group dialogue.

Your greatest concern is your business. It is under investigation from the health department for waste-water disposal violations, and the last thing you need right now is for the ground water contamination to be linked to you. You took a risk when you diverted the wastewater into the town's sewer line, but the cost of repairing your pumps and filters was more than you wanted to pay. You are paying now!

Your questions for the group should be focused on evidence that supports your concerns. You should also, listen to everyone to see who you might be able to influence and who you might need to help defend yourself and your business.

Role Card 3: Town Council Member – Business Owner – Dr. Sarah Cooksalot – Cooksalot Veterinary Clinic

As a Town Council Member, you vote on all town plans and you are also looked to for advice and behavior. Assist in keeping the group talking one at a time and actively listening. You can demonstrate this for the group by using your bounce card when you participate in the group dialogue.

Your greatest concern is for the safety and welfare of the townsfolk and their pets. You are in favor of any plan that protects the environment, people, plants, wildlife, and pets. You are the one who provided the contact information for the university professors and researchers and you called DHEC about the dog food. You are not opposed to Mr. Dixon BUT you do not tolerate his business practices, especially when they endanger life. You believe the town is right to hold him accountable for cleaning up. You think it is a just punishment.

Your questions for the group should be focused on evidence that supports your concerns. You should also, defend your positions and opinions about the environment, life, and your desire for a clean-up plan that is thorough and justified- no matter the cost.

Role Card 4: Citizen & Member of The Sons of Confederate – Mr. Gunny Smith – Hunter and Nature Lover

As a resident of the town of Anywhere you have deep ties to this community. Your great-grandparents were some of the first farmers to cultivate this land. Your grandfather owned the hardware store and you currently own the bait, tackle, and hunting shop. You have hunted in these woods and eaten everything this land has produced. You can show your love of the community by using the bounce cards to participate in the dialogue.

You are concerned that industry and growth are ruining your home and the land around it, and you want to stop that kind of “progress” at any cost. You helped stop the expansion of the highway and the paving of the old logging trails. As a result, the interstate went west of the town by 80 miles. You take pride in participating in the civil war re-enactments and are looking forward to the one this week. You are also concerned by the sudden death of your dog, Sam, and are sure the meat packing plant is responsible.

Your questions for the group should be focused on evidence that supports your concerns and avoids supporting manufacturing.

Role Card 5: Out of town – South Carolina Department of Health and Environmental Control (DEHC) – Emil Dodson

As a SC DHEC worker your primary role is to determine what actions need to be taken to clean up the contamination and stop any further contamination at its source. You are empathetic to the citizens of the town and truly want to help them. You are a state employee and must follow the procedures of DHEC. To show your empathy for the townsfolk, use your bounce card to participate in the dialogue.

You are concerned with following DHEC procedures, identifying the contaminants (if there are more than one), determining the source(s) for the contaminant(s), and advising the town on a Clean-up Plan that prevents further contamination. You are also concerned that the politics and emotions in this small town, especially with the re-enactment coming up, might influence the council to take short cuts to speed up the process. You like the mayor's idea of going slowly and of being rational, but you do *not* share all his motives. You both agree that it is in the best interest of the town to contain the contamination, find its source or sources, and eliminate them.

Your questions for the group should be focused on evidence that supports your concerns and a scientific process for discovering the truth.

Role Card 6 – Researcher and Professor, Dr. M. Townsend – State University

As the lead researcher, your primary role is to direct the collection of samples, specimens, and other data. Your ability to test the samples and collect data is dependent on funding, town politics, and state guidelines. You are doing the best you can to try and solve this contamination mystery, but without a state approved plan of action from the town council, your hands are tied. You are limited to what your small team can collect, measure and test. You have submitted your test results to the town council and are awaiting a plan. To try and fit in with these townsfolk, use the bounce cards to participate in dialogue.

Your greatest concern is that it may take too long to get the plan approved- meanwhile the contamination of the ground water might spread to other parts of the state. As a scientist you can only act on the analysis of the sample testing, specimens and measurements taken from the contaminated areas, and your personal knowledge about the area's living /non-living environment.

Your questioning should focus on collecting more evidence and data, support your concerns and align with seeking more information.

CAUSAL FACTORS: DEBATE WALK-THROUGH (Teacher Guide)

1. Display the table below and have students create one like it. Explain that students will need one row for each team member including self. The first 2 shaded columns (left) are completed individually. The last 2 unshaded columns (right) are completed as a team.
2. Model the Example – Fill in the row, one column at a time using the example and explaining as **you** go (Or create your own example). NOTE: *Make sure students understand that they are to complete the first 2 columns individually.*

Display each of the instructions below (see slide 1 below) as you, the teacher, review, and model one round before teams begin sharing.

FOR STUDENTS:

1. In the first row of your table, record your information and whether you agree, disagree, are unsure, or think it depends (*you can disagree with what your expert group said – your job is to report the causal factor and evidence from the expert group*). (If you select “it depends” be ready to explain what it depends to your teammates – see the teacher’s example).
2. As your teammates share, the other expert groups’ causal factors, record each causal factor in a new row along with the evidence presented.
3. When it is your turn share your first row (the causal factor and evidence from your expert group).
4. AFTER every team member has shared, you may ask questions about the causal factors and evidence they presented.
5. Once all questions have been answered and information clarified, review the evidence for each causal factor and select agree, disagree, it depends, or unsure for each one.

Display each of the instructions below as you, the teacher, review them – Pass out paper copies of 7a – e (see slide 2) for each table. Distribute the Role Cards as instructed in the lesson plan.

6. Inform students that they should assume the identity on their role card and make decisions based on the information the card provides. Use role card 6 to MODEL what it might look like to present a causal factor from the role’s (Scientists) perspective. The PROVIDE TIME for students to assimilate the role and make adjustments to their agreements and evidence.

FOR STUDENTS (see slide 2):

7. The Team’s Choice:
 - a. Each team member will share their choice and explain why- using evidence and information from the role card.
 - b. If another team member chose the same causal factor, they state their agreement. If they have a different reason, they share it- using evidence or information from their role card.
 - c. If a team member chose, “it depends,” they give a brief explanation of what (evidence) it depends upon.
 - d. Team members that disagree will share evidence that they think *eliminates* the casual factor.
 - e. The process repeats until all agreements, disagreements and evidence has been heard.

Display each instruction below, after teams complete “e.” *Paper copies are a good idea here as teams will complete “e” at different rates. (see Slide 3)

- f. Use Forced Choice (see below) to select the causal factor the team will argue for the class.
 - i. Each team member circles their top 3 causal factors
 - ii. Once everyone is finished circling, round robin share. A team member should record the number of responses for each causal factor
 - iii. The causal factor with the most responses is the one that the team will defend. If more than 1, combine them, but be sure the evidence supports a connection between them.
- g. **AS the teacher you can decide whether they must defend their choice as one of the roles OR you can let them choose.**

TO BE DISPLAYED:

Adapted from iDEAL Sessions 2015-2016, Disciplinary Literacy Strategies: Agree/Disagree Statements: Vocabulary Development

Causal Factor	I Think...and why	We Think...	... and Why
Evidence Presented By: <u>John Doe</u> The contamination is peanut butter and it was caused by Dawson's dog, Elmer. Supporting Evidence: In the newsletter Sue said she saw Dawson's dog eat the peanut butter and then lick all the people that got sick.	____ agree <u>X</u> disagree ____ it depends on ____ not sure What it depends:	____ agree ____ disagree <u>X</u> it depends on ____ not sure What it depends: On whether or not the dog's saliva has a contaminant found in the ground water – see column 4	Additional evidence or reasoning: Dawson's dog did not get sick. The peanut butter was eaten by other's who did not get sick. But Dawson's dog did lick everyone who was sick. Next Steps might be to collect saliva samples from Dawson's dog
Evidence Presented By: _____ Supporting Evidence:	____ agree ____ disagree ____ it depends on ____ not sure What it depends:	____ agree ____ disagree ____ it depends on ____ not sure What it depends:	Additional evidence or reasoning:

SLIDE 1 (Student's paper copy and display)

FOR STUDENTS:

1. In the first row of your table, record your information and whether you agree, disagree, are unsure, or think it depends (*you can disagree with what your expert group said – your job is to report the causal factor and evidence from the expert group*). (If you select “it depends” be ready to explain to your teammates – see the teacher’s example).
2. As your teammates share, the other expert groups’ causal factors, record each causal factor in a new row along with the evidence presented.
3. When it is your turn share your first row (the causal factor and evidence from your expert group).
4. AFTER every team member has shared, you may ask questions about the causal factors and evidence they presented.
5. Once all questions have been answered and information clarified, review your evidence for each causal factor. Select agree, disagree, it depends or unsure for each of them.

SLIDE 1 – Student Copy

FOR DISPLAY:

1. Record the information from your expert group and whether you agree, disagree, are unsure or think it depends on something.
2. Record new causal factors and evidence on new rows – WAIT to ask questions.
3. Share your expert group’s causal factor and evidence with your team.
4. ASK questions WHEN everyone has shared all expert groups causal factors.
5. After hearing everything – INDIVIDUALLY choose the casual factor(s) you think might responsible for the contamination.

Slice 1 – Display Copy

Slide 2 (Students paper copy and display copy)

STUDENT COPY:

TEAM DEBATE Part 1: Causal Factors & Evidence

- On your turn, share one of your agreements or it depends choices for ONE cause of the contamination and explain why. Make sure you are using your role card and that your choices support the information on the card.
- If teammates agrees with you, they will let you know. If they have different evidence be sure to listen carefully and record it in your table.
- If a team member chose, "it depends," they give a brief explanation of what (evidence) it depends upon be sure to record this in your table.
- When a team member shares a causal factor you agree OR disagree with – WAIT your turn, then give EVIDENCE (or information from your role card) that you think supports OR eliminates the causal factor.
- Team members that disagree will share evidence that they think eliminates the casual factor. Listen carefully and record information you need to defend your choice OR to change it. *It is expected that you will change some of your choices.*
- The process repeats until all agreements, disagreements and evidence has been heard.

SLIDE 2 – Student Copy

FOR DISPLAY:

TEAM DEBATE Part 1: Causal Factors & Evidence

- Share one of your choices and using evidence, explain why.

-OR-

- Agree with your teammate(s) and share NEW evidence ONLY (You can also share an it depends here OR wait until your turn to share).
- BE SURE to provide an explanation for an "it depends".

Repeat Round Robin style until everyone has shared ALL their Agree and It Depends causal factors.

- Share evidence ONLY (use the golden rule) that you think eliminates the casual factors your teammate(s) have presented.
- Go Round Robin style until ALL evidence and arguments have been heard. Evidence should be provided to support your reason for disagreement OR why you are not sure.

Slide 2 – Display Copy

Slide 3 (A & B)

A: Display First

TEAM DEBATE Part 2: Forced Choice

- Circles your top 3 causal factors – the top three things that might have caused the ground water contamination.
- Once everyone in your team is finished circling, round robin share, ONE causal factor at a time. The order does not matter.
- Have a team member record the number of times a causal factor is shared.
- Continue sharing until everyone has shared their top 3.

Slide 3 Display First

B: Display next

TEAM DEBATE Part 2: Forced Choice

- Circles your top 3 causal factors – the top three things that might have caused the ground water contamination.
- Once everyone in your team is finished circling, round robin share, ONE causal factor at a time. The order does not matter.
- Have a team member record the number of times a causal factor is shared.
- Continue sharing until everyone has shared their top 3.
- The causal factor with the most responses is the one the team will defend. IF there are 2 or more causal factors tied for the most, combine them, but be sure the evidence supports a connection between them.

Slide 3 Display Last

Teams Rubric

Criteria	5 points	4 points	3 points	2 points	1 point	Total Points
Respect for Other Team	All statements, body language, and responses were respectful and used appropriate language	Statements and responses were respectful and used appropriate language, but once or twice body language was not appropriate.	Most statements and responses were respectful and used appropriate language, but there was one sarcastic remark	Statements, responses and/or body language were borderline appropriate. Some sarcastic remarks	Statements, responses and/or body language were consistently disrespectful	
Information	All information presented in this debate was stated clearly, accurately, thoroughly, and purposefully	Most information presented in this debate was clear, accurate, thorough, and purposeful	Most information presented in the debate was clear, accurate, but was not usually thorough and/or purposeful	Some information was accurate, but there were some minor inaccuracies	Information had some major inaccuracies OR was usually not clear, or purposeful	
Rebuttal	All counterarguments were accurate, relevant and strong	Most counterarguments were accurate, relevant, and strong	Most counterarguments were accurate and relevant, but several were weak	Some elements of the counterarguments were weak and irrelevant	Counterarguments were not accurate and/or relevant	
Use of Facts/Statistics	Every major point was well supported with several relevant facts, statistics and/or examples	Every major point was adequately supported with relevant facts, statistics and/or examples	Every major point was supported with facts, statistics and/or examples, but the relevance of some was questionable	Some points were supported well, others were not	All points were not supported	
Organization	All arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	Some arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	A Few arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	None of the arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion	
Understanding of Topic	The team clearly understood the topic in depth and presented their information forcefully and convincingly	The team clearly understood the topic in depth and presented their information with ease	The team seemed to understand the main points of the topic and presented those with ease	The team seemed to understand the main points of the topic, but didn't present with ease	The team did not show an adequate understanding of the topic	
Total Points:						
Comments:						

Source: <http://course1.winona.edu/shatfield/air/classdebate.pdf>

Team Rubric

Team Name and Position: _____

Name of Assessor: _____ Date: _____

Circle only one number per statement.

(strongly agree = 5, agree = 4, undecided = 3, disagree = 2, strongly disagree = 1)

- | | |
|--|-----------|
| 1. The team's statements clearly supported their position in the debate. | 5 4 3 2 1 |
| 2. The team's statements appeared to be well researched and documented. | 5 4 3 2 1 |
| 3. The team addressed the opposing team and made appropriate eye contact. | 5 4 3 2 1 |
| 4. Arguments were presented with clarity and appropriate volume. | 5 4 3 2 1 |
| 5. Members were well organized and collaborative with each other. | 5 4 3 2 1 |
| 6. Rebuttals were specific to opposing arguments and expressed with clarity. | 5 4 3 2 1 |
| 7. Rebuttals showed evidence of good listening skills. | 5 4 3 2 1 |
| 8. Concluding arguments and statements were effective and convincing. | 5 4 3 2 1 |
| 9. Team adhered to the rules. | 5 4 3 2 1 |
| 10. The overall collective effort of the team was effective. | 5 4 3 2 1 |

Additional Comments:

Peer Collaboration Rubric

	4	3	2	1
Participation	Complete: Always on task and includes others.	Full: Mostly on task and includes others.	Moderate: Wasted some time and/or got distracted.	Minimal: Wasted time and/or got distracted, distracted others.
Leadership	Complete: Posing solutions to problems, giving argument and agreement, assisting teammates, always has a positive focused attitude. Models the above behaviors and shares decision making, tasks and action items.	Full: Sometimes assumed leadership in an appropriate way (see 4).	Moderate: Usually allowed others to assume leadership, or often dominated the group.	Minimal: Shows no interest or leads others non-productively.
Listening	Completely: Always Pauses, paraphrases and asks productive questions. Accepts other's ideas and weighs them equally – shows objectivity.	Full: Frequently Pauses, paraphrases and asks productive questions. Accepts other's ideas and weighs them equally – shows objectivity.	Moderate: Rarely pauses, sometimes paraphrases, usually asks productive questions. Listens to other's ideas but is not objective.	Minimal: Pouts or is disdainful when others disagree. Rarely pauses or paraphrases, questions are usually biased. Rarely listens to opposing ideas.
Feedback	Completely: Offers detailed, constructive, and objective feedback when appropriate.	Full: Offers detailed and constructive feedback when appropriate.	Moderate: Offers details for both constructive and ineffective feedback, usually when appropriate.	Minimal: Does not offer constructive or useful feedback.
Cooperation	Completely: Treats everyone respectfully and shares the workload equitably.	Full: Usually treats everyone respectfully and shares the workload equitably.	Moderate: Mostly respectful and usually shares the workload fairly.	Minimal: Disrespectful and/or does not share the workload fairly.
Time Management	Completely: Always finishes assigned tasks on time and helps others utilize time in an efficient and effective manner.	Full: Always finishes assigned tasks efficiently and effectively.	Moderate: Usually finishes assigned tasks efficiently and effectively, but occasionally needs assistance.	Minimal: Caused delays, works inefficiently and must be assisted or dismissed from the task to serve the group effectively.

Write the number of the description that fits each group member

4 = Complete: no need to improve;

3 = Full: has areas which could be improved;

2 = Moderate: progressing but needs improvement in some areas;

1 = Minimal: needs improvement and possible assistance.

Team Member Name	Participation	Leadership	Listening	Feedback	Cooperation	Time Management