Overview

Unit Topic: The Science of Sleuthing, Solving Mysteries with Sherlock

Lesson Topics (and potential activities) (to be connected to standards in lesson plans):

1. The art of deduction/the nature of science
    a. Mystery box
    b. Observation video
    c. Mirror activity?
    d. Paper cutout activity
    e. Graph Reading
2. Mystery part 1: which food was poisoned?
    a. Fake puke lab--analyze fake vomit for food type (sugar, starch, fat) and match with the potential restaurant sources
3. Mystery part 2: Catch the crook!
    a. Fingerprinting
    b. DNA analysis? Do we have access to gel electrophoresis tools? Cuz we could do it with food coloring really easily.
    c. Maybe some genetics
4. Mystery part 4: Science escape room
    a. Chemistry? Rube Goldberg machine?
5. Mystery part 5: The Trial
    a. CER: Claim, Evidence, Reasoning
    b. Compile their findings to put the criminal behind bars

Lesson 1- Nature of Science

February 8, 2020

Lesson Topic: The Art of Deduction, the Nature of Science

NGSS:
NGSS Appendix H: The Nature of Science in NGSS
Scientific Investigations Use a Variety of Methods
Scientific Knowledge is Based on Empirical Evidence
Scientific Knowledge is Open to Revision in Light of New Evidence
Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
Science is a Way of Knowing
Scientific Knowledge Assumes an Order and Consistency in Natural Systems
Science is a Human Endeavor
Science Addresses Questions About the Natural and Material World

Indiana Math:
4.DA.1: Formulate questions that can be addressed with data. Use observations, surveys, and experiments to collect, represent, and interpret the data using tables (including frequency tables), line plots, and bar graphs.

Objectives
Students will be able to…

1. Describe the tentative, subjective, creative, empirical, socially/culturally influenced, and observation/inference-based nature of science.
2. Connect the nature of science to skills that are needed to solve crimes.

Materials Needed:

1. Video: https://www.youtube.com/watch?v=ubNF9QNEQLA
2. Mystery box (provided by Andrea)
3. Blue and yellow food coloring, one bottle of each
4. Small mirrors, one per student
5. Five blank posters (or sheets of chart paper)
6. Mirror activity handout (one per student, in appendix)
7. Blank paper (plenty, at least 2 per student)
8. Construction paper, one sheet per student

9. Markers
10. Scissors, one per pair of students
11. Tape

Safety Issues: None.

Time	Teacher Does	Student Does
9:30	ENGAGE Sherlock Holmes explains that these students have been recruited to become his new crime-solving team, but in order to be true detectives, they need to undergo some training. First, a test. Show the crime scene video. Pause when asked if they noticed the changes. Students will be confused, ask if they can list any, they probably won't be able to. Remark that "clearly we have some work to do." Show the rest of the video. Ask: What are some skills you think you will need to be a detective like Sherlock? Take student answers and explain that we are going to use our science skills to help us be good detectives. Connect to what they said, and explain that we are going to try to come up with some things we know about science and see if they can help us be good detectives.	Watch video, note any changes that they noticed. Volunteer answers
9:35	EXPLORE Throughout the explore section, the instructor should create a running list of NOS tenets so there is a definition visible to all students. <u>Mystery box activity</u>: Instructor pours water in the mystery box, manipulating so that water comes out different colors every time. In between each pour, in partnerships students will draw what they think the inside of the box looks like, and volunteers will draw their ideas on the board. Discussion - Observation and inferences: students used their observations to infer what the inside of the box looks like - Empirical: they were creating their ideas	Throughout explore, students participate in activities and discussions, both alone and in partnerships.

	based on data - Creative: they had to use their creativity to decide what the inside of the box might look like - Tentative: Their ideas changed as they get more evidence	
9:55	Mirror activity:(paper in appendix) students practice writing in the mirror. Discussion - Ask: why is this so hard? Why does your brain have such a hard time doing this? Hopefully they talk about how this isn't the way they learned to write. - Socially/culturally influenced: your experience influences how you see things/do things in science	
10:10	Paper cutout activity: students work in pairs, one partner draws a picture (of anything, ideally something large that covers most of the paper), and the other cuts small holes in a sheet of construction paper. They create a sealed envelope using their holey paper and their artwork, so the artwork peeps through the holes. They trade their envelop with another partnership, and try to recreate the picture based on what they can see through the holes. Discussion - Take your artwork out of the envelope. How close were you? They will probably want to hold it up and show it. - How is this like science? - Subjective: people have different opinions looking at the same picture - Creative	
10:45	Data literacy activity: What's Going On in This Graph? | Nov. 28, 2018 What's Going On in This Graph? | Oct. 10, 2017 What's Going On in This Graph? | Nov. 14, 2018 Students will visit the three links above and view the graphics there. For each graph they will answer	

	the following questions ● What interesting thing do you notice about this graphic? ● What is your hypothesis about why that interesting thing is happening? ● What could you do to gain evidence to support this hypothesis? After students finish. While class will vote on one graph they want to discuss as a class. We will put it on the board and discuss it together.	
11:15	EXPLAIN How do you think science can help us solve mysteries? Students will work with groups, and each will be assigned one of the tenets of the nature of science that we learned about. With their group, they will make a poster about that tenet, and how it will help us solve mysteries. They will then present it to the whole group, and we will keep these in our Saturday Science room to refer to each week.	Create a poster about their assigned tenet with their group to be displayed in the SS room, and present to the class
11:45	EXTEND Sherlock bursts in and explains that there has been a crime committed right here on campus. Someone has poisoned the food at a big school event, and he needs the students' help to solve it. Good thing we've been honing their detective skills! Here's what we know so far: - There were three different restaurants who provided food for the party. - Each guests had to select one food option. - Not every guest who ate at the part was poisoned. What other evidence do we need to gather to figure out who poisoned the food? How can the things we have learned about science help us solve this crime? We will start gathering some evidence and see what we can do to solve the crime!	Students provide their ideas to answer this question. Maybe TPS.

EVALUATE:

Students will display their understanding of the learning objectives throughout this lesson. In the Explore section, instructors will gather student understanding from student participation and contribution to discussion. In the Explain section, instructors will have the opportunity to see students synthesize the information on their posters, and connect it to solving mysteries.

Appendix, Documents needed:

Mirror Activity:

Using the mirror you will be given, hold the mirror above your head, parallel to this piece of paper on the table and facing the table. Your task is to look up into the mirror and copy the images you see below. You will then write your name on the bottom, while only looking into the mirror. No peeking!

Lesson 2- Murder and a Meal

Lesson Topic: Mystery Part 1: Which food was poisoned?

NGSS:
Science and Engineering Practices:

- Planning and Carrying Out Investigations
- Constructing Explanations and Designing Solutions
- Asking Questions and Defining Problems
- Engaging in Argument from Evidence
- Analyzing and Interpreting Data

Objectives:
Students will be able to…

1. Identify components of a substance based on their interactions with other substances in a laboratory investigation.
2. Make a claim about the substance based on evidence from the investigation.

Materials Needed:

- Murder and a Meal Powerpoint: https://docs.google.com/presentation/d/11gvrIcrJU6jig1TswoFcCm5DRkS7kY7wTR-cFax6ECA/edit?usp=sharing
- Fake vomit (made by instructors)
- Starch powder
- Vegetable oil
- Meat mush (smashed hot dogs)
- 125mm test tubes, 9 per group of four
- Test tube clamps, one per group
- Test tube racks, one per group
- Droppers, a couple per group
- Small beakers, one per group
- Glass marking pen, one per group
- Goggles, one pair per student (and a pair for each instructor)
- Aprons if available, one per student
- Biuret solution, 3-4 bottles
- Paper bags, one per group
- Iodine solution, 3-4 bottles

Safety Issues:
Food substances--need to communicate to students that substances are not to be eaten. Also need to ensure that none of the used food substances are an allergen for students.

Time	Teacher Does	Student Does
0:00	ENGAGE Sherlock reviews with the students what science is, and introduces the very specific kind of science we will be dealing with--forensic science. Open it up to the kids--what is forensic science? Where have you heard that word before? What have you seen on TV? Compile a list of characteristics of forensic science. They may notice that it might include some chemistry, working in a lab, some medical experience, maybe some anthropology experience to work with bones. And that's what it should be! Forensic science is a combination of many different fields to solve crimes. Lead a discussion about how what we see on TV is not totally accurate. Students may want to share what they've seen that might not be totally true, like vamping up the resolution on a super grainy photo.	Share their ideas about what forensic science is, what it consists of.
5:00	EXPLORE Explain to students that we have gathered some of the evidence we need to solve our crime. We can use some aspects of forensic science to help us solve this crime. One of the first things we need to find out is which of the restaurants catering the party had their food poisoned. None of the sick party attendees stuck around long enough for us to ask them which food they are! BUT we do have the vomit they left behind on the floor… gross! But useful. What WE need to do is analyze the vomit and figure out which food the poisoned people ate to help us figure out which restaurant had their food poisoned! First, we need to learn about some of the molecules that	

	make up the things that we eat.	
8:00	Go through the PowerPoint (see materials) about the three major macromolecules in our food- protein, fat, starch. Make this a discussion- provide an example of each macromolecules and then open up to their ideas for some other examples. Then introduce in the PowerPoint the three restaurants providing food- ask the students which kinds of macromolecules would be prevalent in the food from that restaurant. Give them three minutes to brainstorm with their group.	Discuss which kinds of macromolecules would be present in the food from each restaurant as a group.
	Pass out the document they can record their ideas on. First, they will make a chart to record whether we do or do not expect the presence of certain macromolecules in the food. Note: probably best to have a blank table available so we don't have to worry about messy lines. Have a discussion as a group- what macromolecules would we expect to see	Record ideas in a chart Share ideas with the group
20:00	in the food from each restaurant? Once the chart is filled out, in the PowerPoint introduce the tests we can use to determine whether a macromolecule is present in the food.	
	Give them the list of materials they will have to conduct this investigation- give them five minutes to figure out how they can set up their investigation to figure out which food was poisoned. Materials: fat control, starch control, sugar control, protein control, vomit, three indicators, test tubes, water	With their group, brainstorm how they could conduct this investigation.
	Bring them back together to report on how they might design this investigation. They should be able to use the controls to give them examples of what the indicators will look like if the macromolecules are or are not present. Then they can use the indicators to test samples of the vomit. Compare their results with what they expected to see for each restaurant. This is another opportunity to create a data table as a class- what information do we need to record, and how can we organize it?	Share ideas with the group

30:00 35:00	NOS connection- did we all come up with the same ideas? Is there one way to come up with the answer? What other aspects of NOS have you noticed as we design our investigation? Refer to the posters they made. Instruct them that first we will test our indicators so that we know what to look for when we use the indicators on the vomit. At your table, you have the indicators, water, and a substance that definitely contains each macromolecule. Why would we want to have these substances that for sure have the macromolecule? And how can we use the water to help us decide what the indicator will look like in the presence of the macromolecules? Guide discussion on the use of controls to compare. Perhaps think-pair-share so everyone has a chance to voice their ideas. Then, explain how to use each indicator. Put dime-sized drip of substance on the paper bag to test for lipids. Add 5mL of iodine to test for carbohydrates. Add 5 mL of biuret to test for protein. Demonstrate how to stir a test tube to ensure that students do not spill or get an unnecessary amount on their fingers. Set them loose to try out the indicators, and fill out their data table recording what the indicators look like with and without their macromolecule present. When they are finished, bring them back together and make sure everyone has reached a consensus on what we are looking for, show them pictures in the ppt to ensure they know what they're looking for.	Connect what we've discussed so far to NOS using the posters they created. Contribute to discussion, TPS Test the indicators on the water and the fat, protein, and starch controls to fill in the data table of what they should see.
60:00	EXPLAIN Now we need to use what we learned from the indicators to determine which macromolecules are present in the vomit, and thus which restaurant the poisoned food came from. Instruct students to try out the indicators on	

	the actual vomit, and record what they see. What macromolecules are present in the vomit? Which restaurant does that match with? Bring class together and see which restaurant they decided, and why. If there are differences, talk about NOS.	
80:00	EXTEND Now that we have narrowed down which restaurant the poisoned food came from, we need to come up with what kind of evidence we should gather. Brainstorm with their table mates what we could gather from the suspects. Have a discussion of who the suspects are, and go over some vocab (suspect, perpetrator, evidence).	
	*this lab will likely take longer than expected, so have some extra activities ready just in case. Potential activities to add to the end: https://a2zhomeschooling.com/explore/chemistry_kids/csi_unit_study_forensics_for_kids/	

Student Worksheet

Name_____

Murder and a Meal

We have collected the vomit from the people who got sick at the party--since we weren't at the party, we weren't able to ask the sick people what they ate! Analyzing their stomach contents will have to do. This will help us discover which food at the party was poisoned!

First, we need to figure out which macromolecules we would expect to find in which foods.

Now, record what we would expect to see with each of the special indicators. Remember your lab safety!

Macromolecule	**Test**	**Positive Results (Macromolecule is THERE)**	**Negative Results (Macromolecule is NOT THERE)**
Lipids	Paper Bag		
Protein	Biuret Reagent		
Carbohydrate (Starch)	Iodine Solution		

Now it is time to test out our indicators on the vomit.
What happens when you use each indicator?

Indicator	Which macromolecule does this show?	What happens when you use it on the vomit?	Is the macromolecule present?
Paper Bag	fats	It looked like oil, dark, spread out	Yes
Biuret Reagent	protein	Turned purple	Yes
Iodine Solution	carbohydrates	Stayed the same color	No

Which macromolecules are present in the vomit?
_____Protein_____
_____Fats_____
_____

Finally: Which restaurant do you think the poisoned food came from?

_____Buffalo Wild Wings_____

Why?

_____

_____

_____

____

Lesson 3- Who Dunnit?

Lesson Topic: Mystery Part 3: Identifying the Perpetrator

State Core Curriculum Standard and Objective:

Objectives:
Students will be able to…

- Draw conclusions based on evidence
- Eliminate potential suspects based on evidence
- Make a claim about which suspect is the perpetrator, using evidence

Materials Needed:

- Dishes with fingerprints on them (helps to put oil or butter on finger to create print)
- Cocoa powder
- Clear tape
- Small paint brush
- Microscope slides
- Hair from suspects
- Microscope

- Water
- Paper towel
- Four brands of black marker
- Handwriting samples from suspects
- Printed materials included at the end of this lesson

Time	Teacher Does	Student Does
0:00 15:00	ENGAGE Time to test their forensics skills--have a discussion about what forensic science means, what have they seen on tv? Is that real? Review what we learned about the restaurant, and review what evidence we gathered from the employees who were working the night of the crime. EXPLORE Stations: Students will have 20 minutes at each station, and a packet to use to keep track of their evidence. 1. Fingerprinting. We have gathered the kitchenware used that day at Olive Garden to prepare the food. Each group will be given one piece of kitchenware and told to analyze it for fingerprints. Instructions at the station detail how to gather the fingerprints. Each student will be assigned a role so everyone participates at the station. A folder will be at the station that contains a document with pictures of the fingerprints of all the employees--they will have to decide which employee matches the fingerprints they found. (did not do this station: couldn't get cocoa powder to work at home) 2. Criminal Witness: This station contains video recordings of interviews with people who witnessed the food get dropped off. The students will have to take what they heard in the interviews and agree on a description of the perpetrator. Once they have their description, they can open the folder on the table and write down which employees match their description. 3. Handwriting analysis: We have collected the slip of paper where the offending employee wrote down the catering order before making it. We also have each employee's application from when they	Recall what we learned last time Go to each station and follow the instructions on the packet to try to narrow down which employee at the restaurant poisoned the food. As they go, they will complete the associated packet.

	applied to the restaurant--the students are to analyze the handwriting from the documents and determine which employee's handwriting matches the one from the order slip. The station will have tips on what to look for when analyzing handwriting. 4. Black pen chromatography: We have collected each employee's black marker--they all use different kinds to write down orders. At this station, students will write with each of the pens on paper towel and do paper towel chromatography to match up with pen matches the one used to write the order. Then they can open the folder and see which kind of marker is used by each employee. 5. Hair sample analysis: we have collected hair samples from each employee, as well as a strand of hair that was on the container for the poisoned food. They will examine the pieces of hair under a microscope and determine which suspects may match the hair we found.	
1:35	EXPLAIN/EVALUATE Using their evidence, with their group they will make a preliminary claim about who the criminal is. Remind them that their claims must be backed up with evidence.This also acts as an evaluation on their deduction skills, and their ability to make scientific claims backed by evidence.	Students will compile their evidence to make a claim about who the perpetrator is within the CER framework to prepare them for the trial.
1:45	EXTEND They are going to use their detective skills to solve some more mysteries, practice their critical thinking, and also practice working together to solve a mystery. https://allesl.com/detective-clues-solve-mystery-puzzle-worksheet/ http://www.edteck.com/rigor/lessons/detective/clues2.pdf	

Station Sheets

Station 1: Fingerprinting

Evidence:

- Dishes used to prepare food the night of the crime, with fingerprints from the employees who used the dishes.

Scenario: You need to figure out **which employees helped prepare the food** the night of the crime! One of them will likely be the perpetrator.

Fingerprinting

- Fingerprints are the ridges on your fingertip.
- Every single person on earth has unique fingerprints! There is no one on earth who has fingerprints just like you.
- There are three kinds of fingerprints:

- Take a look at your fingerprints. Do you have loops, arcs, or curls? Each finger will probably look different!
- In forensic science, we can find fingerprints at a crime scene, and match them to the fingerprints of our suspects to figure out who committed the crime!

What you need:

- A dish (contains fingerprints)
- Clear tape
- Cocoa powder (don't eat it!)
- A small brush
- Black paper

What you'll do:

1. Very carefully pick up your dish, and look for the black circles. We have circled where you can find the fingerprints!
2. Dip the brush into the cocoa powder and very carefully dust the area inside the black circle. You should see the fingerprint appear!
3. Take a piece of clear tape and carefully press it onto the dusted fingerprint, and peel it off. You have collected the print!
4. Once you have gathered a piece of tape with the fingerprints of the various employees on it, open the folder and see if you can match any fingerprints to our records.
5. Be sure to complete your worksheet as you go.

In the folder:

Fingerprinting:

Name	Thumbprint
John	
Robert	
Susan	
Tyler	
Stephanie	

Do any of the fingerprints you collected match the ones here? Record them in your packet!

Cleanup Instructions:

- Clean up any spilled cocoa powder
- Return your bowl to an instructor

Station 2: Establishing Motive

Interview with John:
Interviewer: Were you aware the party was happening the night you were working?

John: Yeah, my friend was actually hosting the party. But he scheduled for a night that I had to work, so I couldn't go.
Interviewer: Were you angry that your friend planned it for a night you were working?
John: I mean, I wish I could have gone to the party, but I understand that his schedule is pretty busy.
Interviewer: Did you want to ruin the party by poisoning the food?
John: What? No! He's my friend, why would I want to ruin his party?

Interview with Robert:
Interviewer: Were you aware the party was happening the night you were working?
Robert: I don't know, there are a lot of parties going on on campus every weekend.
Interviewer: Do you usually attend these parties?
Robert: I used to go with my girlfriend before we broke up, but now I don't have anyone to go with.
Interviewer: Do you think your ex-girlfriend was out at a party the night of the poisoning?
Robert: I don't know, probably. She's probably looking for a new boyfriend by now.
Interviewer: Does the thought of her having fun without you make you angry?

Robert: (getting defensive) no, I don't care! I don't care that she was at the party! Why should I?

Interview with Susan:
Interviewer: Were you aware of the party taking place the night of the crime?
Susan: Yes, I'm always working the night of these parties. The host always puts in huge catering orders last minute, it's a big hassle for us.
Interviewer: Did you poison the food to make sure they didn't send in any big orders anymore?
Susan: No way! I don't want to lose my job, even if their orders are a hassle, it means there's work for me to do here.

Interview with Felicia
Interviewer: Were you aware of the party taking place the night of the crime?
Felicia: Oh yeah, I've delivered food to these parties before. They happen every weekend.
Interviewer: You sound annoyed. Do you not like to deliver to these parties?
Felicia: Ugh… The rooms are SO crowded during set-up, and the hosts never bother to tip! I'm not a fan of these parties, I won't lie.

Interview with Stephanie:
Interviewer: Were you aware of the party taking place the night of the crime?
Stephanie: Yes, my daughter keeps me updated on all of the big parties going on on campus.
Interviewer: Was your daughter attending the party the night of the poisoning?
Stephanie: No, she keeps to herself, so she never gets invited to any of the parties.

Station 2: Handwriting Analysis

Evidence:

- The handwriting on the order confirmation (possibly written by the person who poisoned the food)
- Handwriting samples from each of the subjects

Scenario:

Your task is to analyze the handwriting of each of the suspects, and try to decide which of them signed off on the order. Every clue is a possible answer!

Handwriting Analysis

A person's handwriting is about as unique as they are. Analyzing the unique characteristics of someone's handwriting can allow us to identify who wrote something!

Here are some example traits to look for in someone's handwriting:

TRAITS	KEY POINTS		
Baseline	Up	Down	Straight
Slant of Letters	Right	Left	Straight
Letter Size	Large	Medium	Small
Word Spacing	Close Together	Wide apart	Normal
Letter Formation "i"	Dots "i"	Does Not Dot "i"	Stylized "i"
Letter formation "t"	Cross "t"	Does Not Cross "t"	Stylized "t"
Letter Formation "r"	Angle "r" to Point	Flat-topped	Stylized "r"
Letter formation "e"	Looped "e"	Not Looped "e"	Stylized "e"

What you need:

- Handwriting analysis chart (above)
- Handwriting samples from each suspect

What you'll do:

1. On your worksheet, write down the characteristics that are unique to each suspect.
2. When you have identified the characteristics, open the folder to see the handwriting of the person who signed off on the order. Write down the characteristics of this handwriting, then try to match it to potential suspects.

Station 4: Black Marker Chromatography

Evidence:

- The piece of paper with the date of the delivery written by the perpetrator - they would have been the one to write this date on the order sheet before it was delivered.
- 4 markers that may have been used to write the date

Scenario: You need to figure out **which marker was used** to write the date! You will use **chromatography** to analyze the four markers used by the employees and figure out which one matches the one used to write the date. Unfortunately, the date was written on thick paper, so the chromatography didn't work very well when we dipped it in water (science can't always be perfect.) Do your best!

What is chromatography?
Chromatography is a technique used to separate out all the pigments used to make up one color.

Surprise: Most black markers are made up of several other colors!

What you need:

- The four black markers
- Four strips of paper towel
- A shallow dish of water

What you'll do:

1. Place a thin line of each marker about ½ inch away from the bottom of your strip of paper towel. *Make sure you know which marker went on which strip!*
2. Carefully dip the end of the paper towel in the water and hold it there. You should see the water start to climb the paper towel!
3. Watch carefully- which colors do you see for each marker? Keep careful record!
4. Match your results with the evidence. Does it match with any of your paper towel strips?

5. When you have decided which marker was used to write the date, open the folder to see which employee usually uses that marker!

In the folder:

Name	Favorite Marker
John	Marks-A-Lot
Robert	Mr. Sketch
Susan	Mr. Sketch
Tyler	Mr. Sketch
Stephanie	Expo

Darn! Looks like lots of employees like the Mr. Sketch marker… probably because it smells so delicious. Be sure to make your final notes in your lab book.

Clean-up instruction:
Throw away your wet paper towel pieces.
Grab big paper towel sheets from the back to clean up any water you may have spilled.
Make sure the markers are capped and replaced--do not take them with you!

Make sure the evidence sheet with the date is left at the station.

Station 4

Hair Analysis

Evidence:

- Strand of hair found on top of the food container used in the delivery
- Strands of hair from each of the suspects.

Scenario:
We found a strand of hair on the delivery box, and we need to figure out which employee the hair belongs to! You will use a microscope to examine each strand of hair belonging to the suspects, and then compare them to the hair found at the crime scene. Don’t touch any of the knobs on the microscope! It has been set so that you can see each strand of hair. If it needs to be adjusted, let an instructor know.

What you need:

- Five microscope slides, containing hair from five suspects
- Microscope slide containing the hair found at the scene
- Microscope

What you'll do

- Examine each slide under the microscope, and draw/describe what you see. Focus on the characteristics of the strand of hair.
- Determine which suspects' hair matches best with the hair found on the scene.

Clean-Up Instructions

- Make sure all the slides are organized at your station.
- Do not play with the knobs on the microscope so that it is working properly for the next team!

Student Worksheet

Station 1:

Follow the instructions for the fingerprinting, and fill in the following to keep track of your results!

Whose fingerprints are found on the dish that the food was prepared in?

_____

_____

_____

_____

_____

Station 2:

Read the interview excerpts from each of the suspects. For each suspect, record what their *motive* may have been to commit the crime!

Motive: a reason for doing something, like a crime.

Suspect 1, John
Possible Motive:

_____
_____
_____
___

Suspect 2, Robert
Possible Motive:

_____
_____
_____
___

Suspect 3, Susan

_____

_____

_____

___

Suspect 4, Felicia

_____

_____

_____

___

Suspect 5, Stephanie

_____

_____

_____

___

Which suspects do you think had the clearest motive for committing the crime?

_____

_____

_____

Why?

_____

_____

_____

_____

_____

Station 3:

What are some characteristics of each of the handwriting samples? Refer to the table at your station for some examples.

Suspect	Characteristics of handwriting
John	
Robert	
Susan	
Felicia	
Stephanie	

Look at the perpetrator's handwriting in the folder.
What are some characteristics of this handwriting?

_____

_____

_____

_____

____

Who do you think wrote the confirmation on the order?

_____

Station 4:

Follow the instructions for the chromatography, and fill in the following data table to keep track of your results!

Pen Name	Colors that show up

Now look at the evidence of the data written in marker. Which colors show up?

_____

_____

_____

_____

Which marker do you think the perpetrator used?

_____

Open the envelope and see which suspects it could have been! Write them down here:

_____

_____

_____

_____

_____

Station 5

As you examine the strands of hair, draw and describe what you see!

Suspect 1: John Draw:

_____

_____

_____

_____

_____

Suspect 2: Robert Draw:

_____

_____

_____

_____

_____

Suspect 3: Susan Draw:

_____

_____

_____

_____

_____

Suspect 4: Tyler Draw:

_____

_____

_____

_____

_____

Suspect 5: Stephanie Draw:

_____

_____

_____

_____

_____

Now we will compare these strands of hair to the one found at the scene. Look at the final microscope slide

Perpetrator Hair Draw:

_____

_____

_____

_____

_____

Based on your results, who do you think the hair belongs to?

_____

_____

_____

_____

Lesson 4- Escape Room: Gather Evidence

Lesson Topic:

Standards:

NGSS:
Science and Engineering Practices:

- Planning and Carrying Out Investigations
- Asking Questions and Defining Problems

- Analyzing and Interpreting Data

Materials Needed:

- Escape Room packet
- Three containers with 3 -digit locks.
- Black light.
- Escape Room packet for each group. (Appendix I)

Time	Teacher Does	Student Does
0:00	ENGAGE Review what we've learned about the perpetrator so far: we know they were an employee from Olive Garden, and we have the fingerprints of two different employees on the kitchenware used to prepare the food, and eyewitnesses reporting a tall white male with brown hair preparing and delivering the food--there are two employees who fit this description, and both their fingerprints have been found on the kitchenware used to prepare the food. We don't have quite enough evidence to figure out who the criminal is--both employees deny being the one to prepare and deliver the food. How can we figure out who really poisoned the food? At this point Sherlock announces that we have been locked inside! A note has been slipped under the door-- "Stop trying to catch me--you'll never succeed!" The escape room begins! Students will have to use their logic, their knowledge of the nature of science, and what they've learned from the vomit lab and forensics activities to solve the puzzles and escape the room! EXPLORE- The Escape Room - When students get the door open, there is a muddy footprint outside the door--maybe we can use this to finally identify which of the suspects poisoned the food!	
0:20 - 2:30	EXPLAIN: See Appendix I for full Escape Room Packet For a concept map of the flow of the escape room, see Appendix II	Complete escape Room

	Stations: ● Crossword ● Periodic Table ● Black Light ● Reading maps (topographic maps) ● Temperature maps ● Mirror message	

Assessment:
Successful completion of escape room.

Lesson 5- A Message to Sherlock

Lesson Topic: Students make 7 2-3 minute videos summarizing the evidence they have collected over the last several weeks to send to Sherlock/ The police.

State Core Curriculum Standard and Objective:

NGSS Standards and Practices:

- Engaging in Argument from Evidence

Time	Teacher Does	Student Does
0:00	Introduces Activity: Suspect has been caught, but police to to understand the evidence that has been collected.	
0:15	Teacher reviews material from	Students discuss as a class what

- 0:30	Lessons 1, 2, 3, and 4.	they learned throughout the course and what the most important information for the police is.
0:30- 2:00	Sets up the following stations with material: 1. Posters of tenants of science. 2. Pule Lab 3. Handwriting 4. Motive 5. Pen ink 6. Hair 7. Escape Room	Students record a 2 -3 minute at each station summarizing what was learned during each activity and how the evidence obtained led to conclusion that suspect did commit the crime.
2:00 - 2:30	Teacher plays videos for class.	Students vote on which video from each station to send to police.

Appendix I: Escape Room:

Hi Mom—

They found out that I poisoned the food at the party. I've decided to leave the country, at least for a while. I've hidden clues in this package to help you find out where I am. Just don't let it fall into the wrong hands!

I didn’t have much time before I had to leave. I looked at plane tickets, and decided I’d go somewhere in _____. I found a cheap flight to _____ that left in only a few hours. If you want to find me there, go to the intersection of the _____ and _____ line.

Don’t let anyone else know where I am or they’ll arrest me!

Robert

First, watch this video that will teach you what you need to know for this puzzle: **tinyurl.com/adawlcb.** Pay close attention.

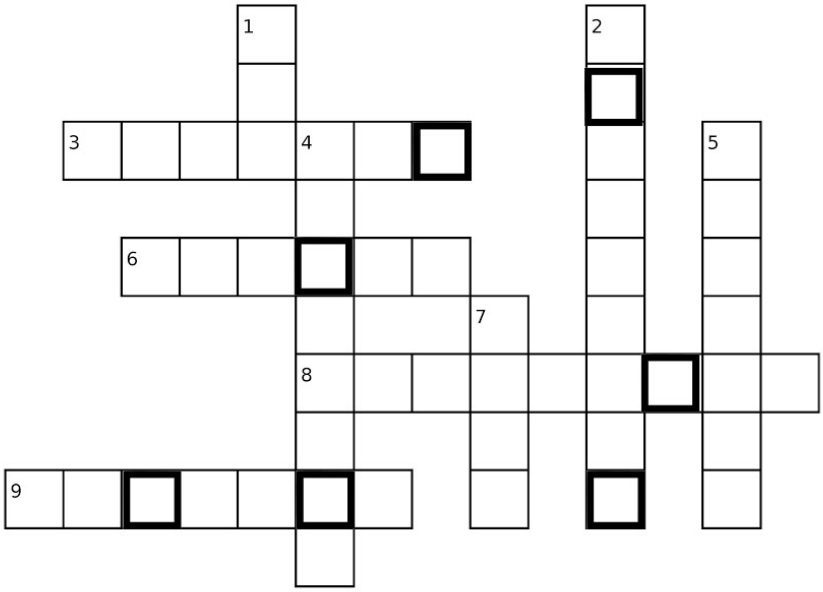
You’ll need a three number code to open my first lockbox. Go to this website: **tinyurl.com/wu5dozk.** Answer the following three questions to fill in the code:

1. By how many percentage points did Clinton win New Mexico? (Round to the nearest percentage point)

2. How many electoral votes does the state of Connecticut have?
3. By how many percentage points did Trump win Florida? (Round to the nearest percentage point)

Code: _____ _____ _____
1 2 3

Crossword Puzzle



Down:

1. The macro-molecule found in oil.
2. A tenant of science that says things in science are never set in stone.
4. Information presented to back up a claim you are making.
5. The name of an animal. Also in the name of the restaurant where the poisoned food came from.
7. Personal ideas that get in the way of our ability to view scientific evidence

Across:

3. The macro-molecule found in meat.
6. The reason that someone may have committed a crime.
8. Something that is based on facts and observation is this.
9. Someone who may have committed a crime.

After you have complete the crossword, unscramble the bolded letters to spell a word. Take the popsical sticks and spell out this word with them. You will still need to find a mirror to read the message on the popsical sticks. Together the mirror and popsical sticks will lead you to the word that goes in the first blank spot in my letter. Once you have discovered this word, you can open the next section of this puzzle.

Alright, now you know I'm in Europe. I've got another video to help you with this next puzzles: **tinyurl.com/yx4ccmde**

Now that you know a little about the napoleonic invasion, go to this website: **tinyurl.com/yx5pc3vy.**

If you need help understanding this graph, you can watch this video: **tinyurl.com/kwbmy33**

You will also need to find an **Important piece of paper hidden in this very room.** You'll need to solve a puzzle based on your map of Napoleon's attack to find this piece of paper.

1. Write out (in words) the number of men alive when Napoleon crossed smarhon. The first letter of this written out number is the answer.
2. The last letter of the word the author of the graphic uses to describe the way the horses are moving when they cross the Neman River.
3. The second to last letter in the name of a city on the dnieper river not passed through by Napoleon.
4. A consonant that appears twice in the city that 33,000 men passed by who had broken off from the main army, and once in the longest-named town on the map.
5. Take the last letter from the city from clue #3 and write it twice.
6. Take the same two cities from #4. This vowel appears a total of 5 times in these two words.

7. The first letter in the last name of the first individual the person who made the graphic says he used “the works of” to create the graphic.
8. Same as number #6.
9. Second letter in the name of the city Napoleon passed through around when he had 175,000 men left.
10. 7th letter in the name of the city on the Berezina River.

O N __ O __ O F __ __ E

1 2 3 4

__ __ S __ __ T __ __ N

5 6 7 8 9 10

You also need a special device in order to find an invisible **message written on the next piece of paper.** This device is in the locked box. Use the same graphic to decode a code word. Tell your teachers this code word and they will unlock this secret device.

1. What are the first two letters of the name of the city on the Berezina river?
2. What is the second letter of the name of the town that Napoleon crossed when he had approximately 127,000 remaining troops?
3. What is the third letter in the name of the first town napoleon passed through during his retreat?
4. The fourth from the last letter of the name of the town that Napoleon crossed around october 18th.
5. The 8th letter in the name of the town Napoleon passed through when it was -30 degrees.
6. 5th letter in the name of the town directly West (left on the map) of the Moskva River.

_____	____	____	____	____	____
1	2	3	4	5	6

Tell your teachers this word and they will give you the key to open the lock box.

3B8V7A

078496

Using your device, write down all the invisible clues on the last piece of paper. Write them in the space below. There should be six in total.

_____

_____

_____

_____

_____

_____

Now give the device you used to find them back to your teacher. The numbers in these clues refer to **elements on the periodic table.** Using your periodic table and the clues, unscramble a word. This is the name of the city I am in.

Tell your teachers the name of this city and they will give you the next set of puzzles. **This city is the word that goes in the second blank in my letter.**

Alright. So you know I'm in London. First watch this video about the London underground: **tinyurl.com/w2c9p5p**

Now, go this URL to open a map of the London Underground: **tinyurl.com/zuyn3**

Use this map to decode a three number code to open the final locked box. You will need to use both your map **and google additional information** to answer these questions.

1. You'll notice that in gray and white in the background of the map are nine "zones." These zones give a general idea of how far away a station is from the center of london. What is the zone number that signifies the center of the city?
2. In what zone is the station closest to the location where the Wimbledon tennis championship is held every year?
3. In what zone do two of the three ends of the black line terminate?

____	____	____
1	2	3

Use this code to unlock the last box.

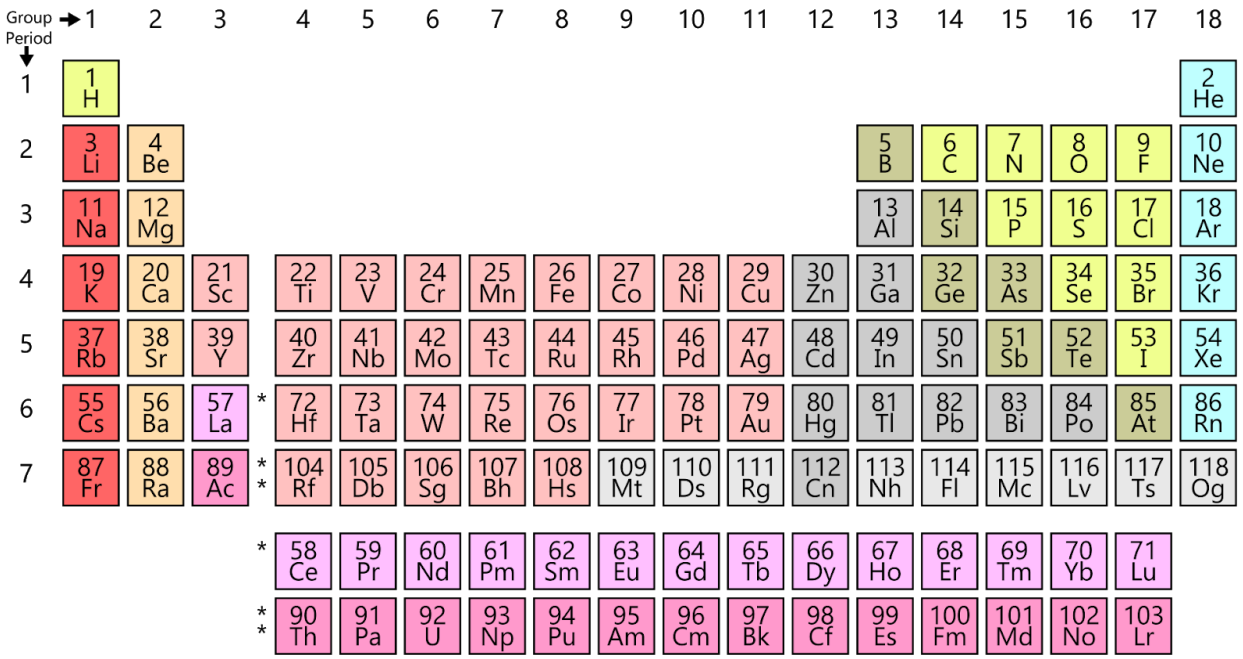
Unlocking the last box should have given you a video to watch. After watching this video, Use the beakers provided to order the rocks from **Largest to Smallest. Make sure you are precise!** This will reveal **two words that fill in the last two blanks in my letter.** Using my completed letter and the other materials from today answer the following question:

Where am I?

Auxiliary Material:

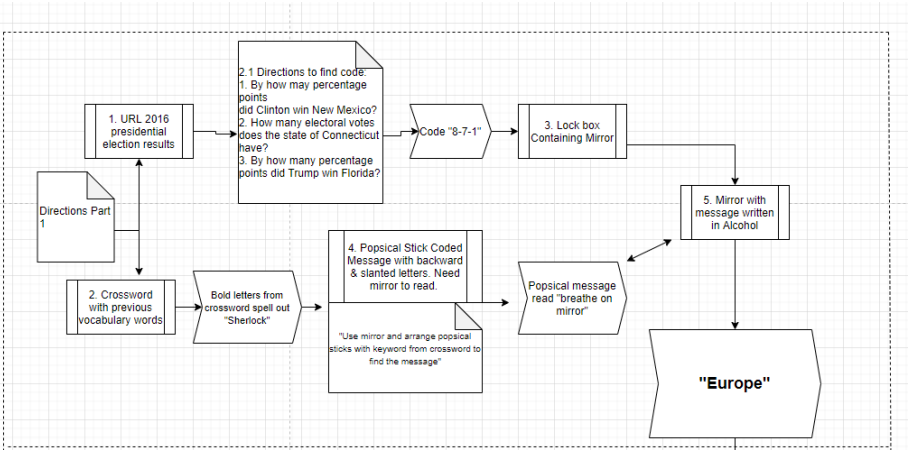
Video URL for second Lock-Box(Cut out):

tinyurl.com/rsy77nh

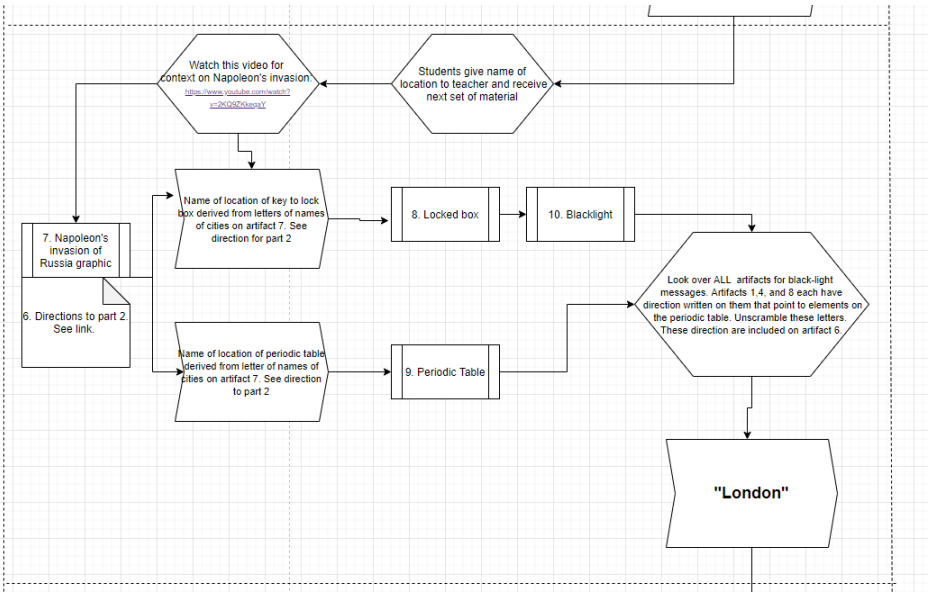

Group
Period
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
1 H He
2 Li Be B C N O F Ne
3 Na Mg Al Si P S Cl Ar
4 K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
5 Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
6 Cs Ba * La Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
7 Fr Ra * Ac Rf Db Sg Bh Hs Mt Ds Rg Cn Nh Fl Mc Lv Ts Og
* Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
* Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr

Appendix II:

Part 1: Understanding Game Mechanics



Part 2: Interpreting Graphs



Part 3: Volume of Solids