

**PBL Unit Title:** Explosives

**Primary Subject Area:** Chemistry

**Interdisciplinary Areas also Covered:** Government, Geography, Technology, English

**Grade/Age Level:** 10-12<sup>th</sup> Grade

**Description of students' role and problem situation:** The student's role is a Clayton detective investigating explosives making at the residences of three suspected terrorists.

**Educational Objectives: (Indicate if unit is interdisciplinary, but only list the objectives from primary subject area)** Interdisciplinary- Government, Geography, Technology, English  
The students identify various types of chemical compounds and chemical reactions.

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**School Location:** Clayton, North Carolina



## MEET the PROBLEM MEMO

Clayton Police Department  
Clayton, North Carolina

### **INTER-OFFICE MEMORANDUM**

DATE: June 3, 2002  
TO: Detective Division  
FROM: Chief of Police  
SUBJECT: Suspected Terrorist Explosives Making

There are suspected terrorists in known locations around the Clayton area. Authorities suspect that they will use explosives to blow up some bridges in the Raleigh area. There is either not enough evidence to obtain a search warrant for the locations of the terrorists or the agents don't want to tip off the suspects by raiding locations that may prove not to be used for making explosives. It is also possible that the explosives have been purchased and are now being used to make large bombs. There have been reports of unusual fume smells in the area of several of the suspects' residences. The SBI knows where clothes of the suspects are laundered. All suspects use public trash pickup. They frequent a local bar in the area called, Shamrock's Tea Room. You as detectives need to find evidence of chemical agents that are used to make explosives. I will need an investigative report on your findings in two weeks at our next meeting.

The above information would be presented to the detectives in a meeting not in writing as the memo suggests. The agenda of the meeting follows:

- What we know. Show slides of: Shamrock Tea Room, laundry/cleaners, and 3 residences.
- Time line
- Budget

# Know/Need to Know Boards

## **Knows:**

1. There are suspected terrorists in the Clayton area.
2. Authorities think the suspected terrorists might blowup some bridges in the Raleigh area.
3. There is either not enough evidence to obtain a search warrant for the locations of the terrorists or the agents don't want to tip off the suspects by raiding the suspected locations where there may not be any bomb making.
4. The terrorists might be making explosives.
5. The explosives might have already been purchased to make large bombs.
6. There have been reports of unusual fume smells in the area of the suspects' residences or businesses.
7. The SBI knows where the suspects launder their clothes.
8. All suspects use public trash and sewage facilities.
9. They frequent a local bar named the Shamrock's Tea Room.
10. The detectives need to determine if the terrorists are making bombs.
11. An answer is needed in two weeks.

## **Need to know:**

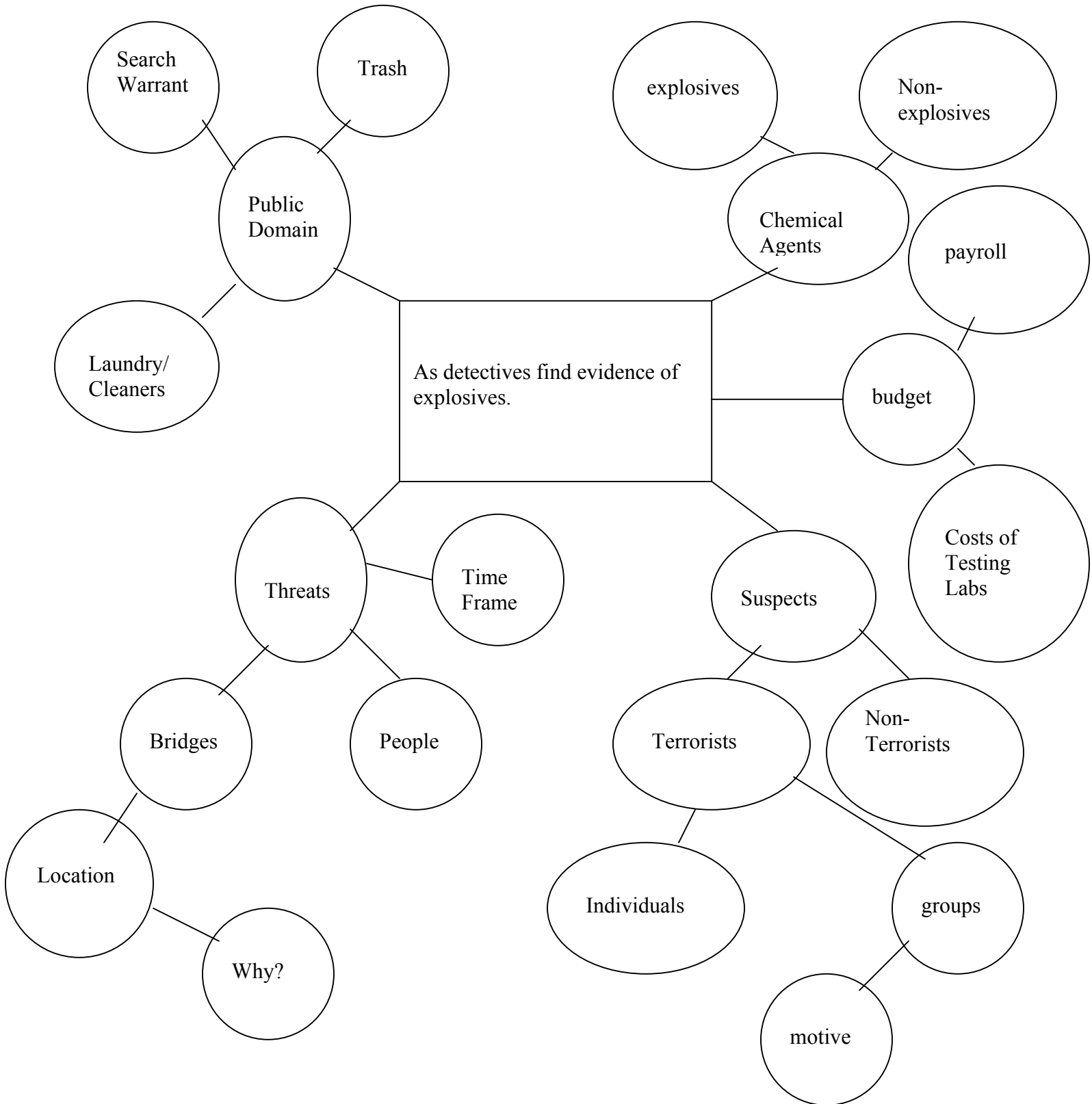
1. Are the suspects terrorists?
2. Are the suspects going to blow up bridges in the Raleigh area?
3. Find out where the bridges are located in the Raleigh area.
4. Find out what evidence is needed to get a search warrant.
5. Where do you have to go to get a search warrant?
6. Find out if the suspects are making explosives.
7. If they are making explosives, what kind are they making?
8. Find out if the suspects have already purchased explosives.
9. If the suspects have already purchased explosives, are they going to make large bombs?
10. Find out what the unusual fume smells are.
11. Find out if the clothes can be taken to the SBI for explosives analysis.
12. Find out if it is legal to search through the suspect's trash for evidence.
13. Find out if the suspects sewage can be taken in to the SBI for analysis and how the sewage could be obtained.

## **Problem Statement**

How can we as detectives determine if explosives are being made at said locations in such a way that:

- We do not arouse any suspicions of the suspects.
- We can protect the safety of the suspects' neighbors.
- We can protect the citizens of Raleigh from harm.
- We can gain enough evidence to either confirm or deny that explosives are being made.
- Complete the investigation in two weeks.

# PROBLEM MAP



## Resources

Matta, M.S., Staley, D.D., & Wilbraham, A.C. (1995). The Behavior of Gases. Menlo Park, CA: Addison-Wesley Publishing Company.

Most expect new attack, survey finds. (2002, May 23). The News & Observer, p. B4

Preparations Stepped Up For Possible New Attacks: Concern Focuses on Power Plants, Trucks, Ships, Bridges. (2001, November 1). The Washington Post, p. A02

U.S. Faulted on Chemical Plants' Security: Government Inaction Leaves Industry Vulnerable Target to Terrorists, Critics Say. (2002, June 13). The Washington Post, p. A10

U.S. Coast Guard. <http://www.uscg.mil/uscg.shtm>

Trace Evidence. <http://sbi.jus.state.nc.us/sbimain/trace.htm>

ATF Field Office. <http://www.atf.treas.gov/field/charlotte/nc.htm>

Senior Inspector, Bureau of Explosives. [Frank\\_stanley@aar.com](mailto:Frank_stanley@aar.com)

Richard S. Johnson, geologist, NC DOT

Officer Kirk Jernigan, SRO for Clayton High School

## CAPSTONE PERFORMANCE

Students will work in groups of 4 or 5 to determine solutions to the problem. After completing the project they will be able to: name and write chemical formulas for a variety of chemical agents, identify chemical equations, and discuss energy transformation, and various forms of energy involved in chemical reactions. They will also acquire the ability to: locate bridges through the use of a map, determine how and when to obtain a search warrant, communicate through writing, speaking, and listening, and use electronic resources for research purposes.

Students will present their final project as an oral presentation in the form of an investigative report of their findings to the Clayton Chief of Police, a detective, and their classmates. The investigative report will include all the lab results of the tests done on the chemical compounds found in the trash and/or on the suspects' clothes and a copy of the investigative report showing what was found in the suspects' trash. The oral presentation will be graded based on a teacher made rubric and the students will assess his/her self.

## Assessment Instrument Rubric

<b>Criteria</b>	<b>Quality</b>	<b>Mediocre</b>
Speech	Speaks clearly with inflection and appropriate volume. Maintains eye contact.	Either speaks clearly with inflection or uses appropriate volume or maintains eye contact.
Presentation	Uses overhead sheets, chart paper or board to present information gathered during the investigation. Information is presented in an organized manner.	Minimal use of visuals such as overhead sheets, chart paper or board, or presentation of information is somewhat organized.
Time	Uses 7 minutes	Goes over 7 minutes
Content	Problem stated and explained, all components of the investigative report are completed, verifying documents are provided, solution stated and explained, solution is workable.	3 out of the 5 components for content are provided
Self Assessment	Stated his/her role and participation in: The Know/Need to Know Board, Writing Problem Statement, Information Gathering and Sharing, and Generating the Solution.	Stated his/her role and participation in 2 of the 4.

# COACHING QUESTIONS

C=Cognition M=Metacognition E=Epistemic Cognition

## Meeting the Problem

C 1. Do you know the location of the Shamrock Tea Room?

M 2. Do you know how to get maps of the bridge locations in the Raleigh area?

E 3. Realistically, would terrorists have motive(s) to blow up a bridge(s) in the Raleigh area?

## Know/Need to Know Board

C 4. Do you know what day of the week the suspects' trash gets picked up?

E 5. What obstacles do you foresee with getting the suspects' trash?

M 6. Where can you go to find out if you can legally obtain the suspects' trash?

## Writing Problem Statements

C 7. What is your role in determining if the suspects are terrorists that are making explosives?

M 8. What resources are you going to need in order to finish the investigation in two weeks?

E 9. What do you think is the main factor to consider in order to determine if explosives are being made at the suspects' residences?

## Information Gathering and Sharing

C 10. Do you understand how to read the analysis of the chemical agents found in the suspects' trash and/or clothes?

M 11. What government agencies might have to be consulted in order to get the chemical agents analyzed that were found on the suspects' clothes or in the suspects' trash?

M 12. Is there a way to analyze the fumes emanating from the suspects' residences?

M 13. How can you verify that the trash you searched belonged to the suspects?

E 14. Which analysis is most important to your investigation and why?

## **Generating Solutions**

C 15. What do you understand from the results of the chemical analysis of the chemical agents found in the suspects' trash and on the suspects' clothes?

M 16. How did the group determine if explosives were being made at the suspects' residences?

E 17. How does your evidence support your decision to apprehend or arrest the suspects?

# Alternative Solutions

## **Possible Solution #1**

Evidence of chemical agents used in making explosives and maps of Raleigh bridges were found in the suspects' trash and/or clothes making it possible for the detectives to obtain a search warrant to search the suspects' residences.

## **Pros**

1. Enough evidence was found to obtain a search warrant to search the suspects' residences in order to gather enough evidence to make an arrest.
2. The field of suspects was narrowed.
3. The detectives know the type of explosives therefore making a possible deduction of how the suspects plan to deliver the alleged explosives.
4. Bridges were saved from being blown up therefore diverting a financial and psychological catastrophe for the citizens of Raleigh and neighboring communities.

## **Cons**

1. The suspects were alerted to the fact that they are being investigated and they left the Clayton area.
2. The chemical agents are the correct type for making explosives but the suspects are not making explosives.
3. The detectives searched the wrong trash.
4. The suspects are not making the explosives at their residences; they are only showering and cleaning up at their residences.
5. The detectives pick the wrong residence to search.
6. The detectives get a false report from the lab.
7. Someone else is using the suspects' trashcan.

## **Consequences**

1. The detectives obtain a search warrant so they can search the suspects' residences for more evidence.
2. The detectives found enough evidence to arrest the suspects.
3. The neighborhood, citizens of Raleigh and Raleigh bridges are safe due to the investigative work of the detectives.

## **Possible Solution #2**

No chemical agents for making explosives were found in the suspects' residences.

### **Pros**

1. The suspects' neighborhood is safe.
2. No explosives are being made.
3. The bridges in Raleigh are safe.
4. The citizens of Raleigh are safe.

### **Cons**

1. The investigation took detectives away from other important investigations.
2. The detectives overlooked evidence in the trash.
3. The detectives were monitoring the wrong suspects.
4. The suspects find out that they are being investigated and sue for false accusations.
5. The lab reports are incorrect.
6. The detectives were sent the wrong lab reports.

### **Consequences**

1. No arrest is made due to the lack of chemical agents found in the trashcan and/or clothes.
2. The detectives cannot get a search warrant to search the suspects' residences.
3. The suspects will not be investigated further and they might be guilty.
4. The detectives will never know if there was evidence inside the suspects' residences.

The solutions are going to be dependent upon the evidence that I put in the trashcan. My plans are to put a variety of substances out on my counter including chemical agents used to make explosives and let another teacher decide what chemical substances go in the trashcan. By allowing another teacher to put the chemical substances into the trashcan I will not be tempted to sway the students to pick one solution over another. If chemical agents used for making explosives were put into the trashcan then solution number one would be the preferred solution because the students should be able to do a chemical analysis on the chemical substances and determine the identity of the substances. Obviously if there are no chemical agents used for making explosives in the trashcan, then the students should pick solution number 2. Once again the students should be able to do a chemical analysis on the chemical substances to determine their identity. However, if the students rush through their chemical analysis and make incorrect assumptions they could end up picking the wrong solution.

## Debriefing Session

On the presentation day the students will present their solutions to their classmates, the Clayton Chief of Police, a Clayton detective, and me in the form of an oral presentation. Before the guests arrive, the groups will be allowed ten minutes to get their materials ready and review their presentations. I will give the students and the guests an assessment rubric for the presentations and go over it. Then I will answer any questions about the assessment rubric and emphasize to everybody to be fair and impartial. Finally, I will encourage everybody to strictly adhere to the assessment rubric. After each group presents their solution, I will ask the students and guests if they have any questions for the group. At that time the students in the audience and the guests may ask any member of the group a question.

After the student presentations, I will turn control of the classroom over to the students to determine the best solution. This process will be student led. In my experiences as a teacher, I have found that there is always at least one student that will volunteer to lead the discussion. It is very possible that the groups will decide on the same solution for the best solution. If this does occur, each group will have to go to the board and put two methods they used to arrive at their solution. When this process is completed there might be new issues that have arisen from the class discussion or concepts that were overlooked. At this point I will have to use coaching questions to lead them to answers for the new issues or overlooked concepts. I might possibly have to use some direct instruction of new issues or concepts, or I might have to elaborate on new issues or concepts.

I will end the presentations by thanking the students for their hard work and presentations, and the guests for their participation and support.