Chemical, Biological, Radiological, and Nuclear Threat Awareness

Objective

Provide Knowledge and Confidence to SBLE Working to Prevent and Respond to Technical Threats

Prepared for:

Texas State University
SBLE Basic CBRN

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Learning Goals

I. Familiarize SBLE personnel with CBRND terminology
II. Describe potential CBRND threats to academic entities
III. Present relevant health and safety considerations from CBRND threats
IV. Suggest CBRND response protocols and differentiate them from other event responses

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Goal I: Learning Objectives

1) Knowledge of CBRN acronyms
2) Knowledge of the types of chemical threats
3) Knowledge of the types of biological threats
4) Knowledge of the differences between radiological and nuclear threats
5) Knowledge of the types of explosive threats

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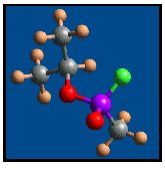
CBRN

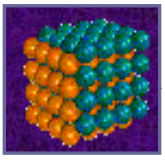
Chemical



- Chemical agents
- Toxic industrial chemicals

Radiological

- Radioactive materials intended to expose or contaminate targets



Activities directed against nuclear facilities

Biological

- Pathogens
- Toxins

Nuclear

- Fissionable materials intended to destroy targets

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Chemical Threats

- Generally represent localized threats
- Mass casualties (> 1000) are unlikely*
- Large quantities of agents/precursors difficult to obtain
- Small scale agent laboratories represent a public safety threat
- Toxic Industrial Chemicals may present the biggest concern for LE

*Ataxia

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Biological Threats

- Effective delivery systems may be more difficult to produce than the agents
- Risks can be localized or widespread
- "Incidents" may be undetected
  - Hence, law enforcement may not be involved in initial incident
- Health care professionals may be the first to encounter victims from an "incident"

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Radiological and Nuclear Threats

- Materials tracked and regulated with some efficiency
- Mass casualties unlikely (without fission)
- Fissionable materials and weapons very difficult to obtain

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Goal II: Learning Objectives

1) List common toxic industrial chemicals
2) Name two classes of chemical warfare agents
3) Define pathogens and toxins
4) Name at least two types of pathogens
5) Recognize the names of common bacteria
6) Recognize the names of common toxins
7) Recognize the names of common viruses
8) Describe delivery techniques for chemical and biological threats

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Types of Chemical Agents

- Toxic Industrial Chemicals
  - Most widely available
- Nerve Agents
  - Most toxic
- Blister Agents (Vesicants)
  - Most persistent

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Toxic Industrial Chemicals

- Chemical manufacturing plants
  - Chlorine
  - Ammonia
- Chemical transportation assets
  - Trains
  - Tank Trucks
- Fuel storage/distribution centers
  - Airports
  - Barge terminals
- Pesticides/insecticides

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Nerve Agents

- Designated by G (German) or V (Victory or Venomous) two-letter codes
  - Tabun (**GA**)
  - Sarin (**GB**)
  - Soman (**GD**)
  - **GF**
  - **VX**

- Symptoms generally observed in seconds to hours

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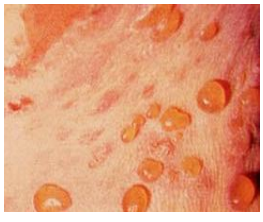
Blister Agents (Vesicants)

- Vesicants produce vesicles or blisters
- Sulphur mustard (**HD**)
- Nitrogen mustard **(HN**)
  - Mustard agents (smell like mustard, taste like garlic—color from yellow to dark brown)
- Lewisite (**L**)
  - Arsenic agent (smells like geraniums)
  - Effects similar to HD and HN
- Phosgene Oxime (**CX**) (not to be confused with Phosgene)
  - Produces wheals instead of vesicles
  - Penetrates rubber
  - Immediate pain



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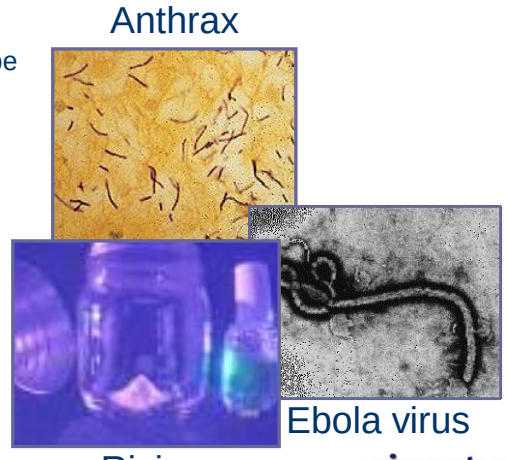
Biological Agents

- Biological agents can be pathogens, which are broadly classified as
  - Bacteria
  - Viruses
  - Other
    - Rickettsia
    - Yeasts
    - Fungi
- Biological agents can also be toxins



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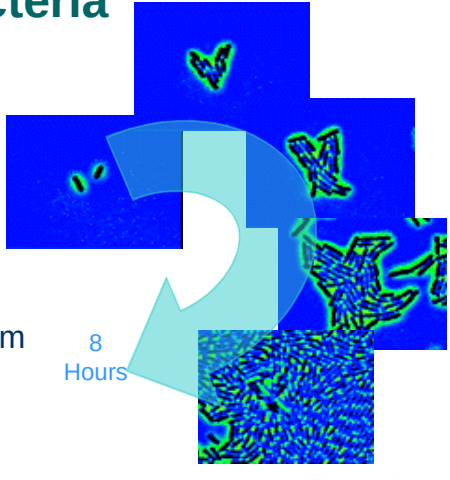
Bacteria

- The smallest organisms capable of independent growth
- Common examples
  - Anthrax
  - Botulism
- Some types can transform into persistent spores



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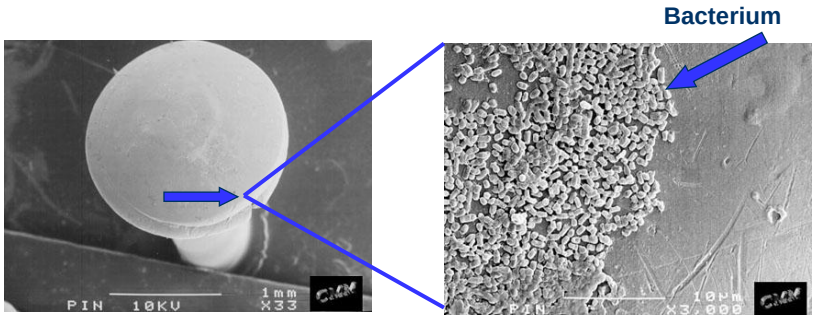
Bacteria on a Pin



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x 3,000

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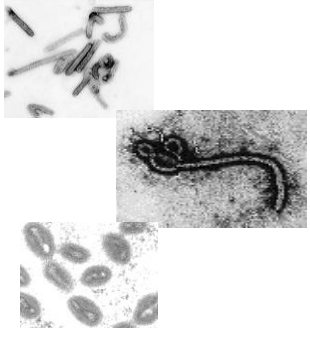
Viruses



- Viruses grow by infecting cells and then killing them
- Common examples include:
  - Ebola virus
  - Marburg virus
- Much smaller than bacteria

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Toxins

- Toxins are poisons of a biological origin
- Examples include:
  - Ricin
  - Botulinum toxin (botulism)

Castor Beans

- Usually do not penetrate through the skin
- More toxic by weight than many chemical agents

Castor Bean Plant

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Potential Absorption

- Most chemical agents will damage or pass through the skin
- Toxins (biological agents), which are generally very complex molecules, do not readily pass through the skin
- It has been suggested that DMSO (dimethyl sulfoxide) can be used to facilitate absorption of toxins
  - This has been disproved

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What Form Will They Be In?

Agent Type	Liquid	Gas	Liquid Aerosol	Dry Aerosol	Powder
Chemical	✓	✓	✓	✓	✓
Biological	✓	✗	✓	✓	✓

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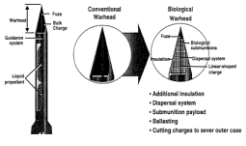
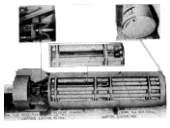
Military Delivery Systems

- Cylindrical bomblets
- Spherical bomblets
- Other submunitions
- Spray tanks





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Garden Sprayers

Readily available and inconspicuous

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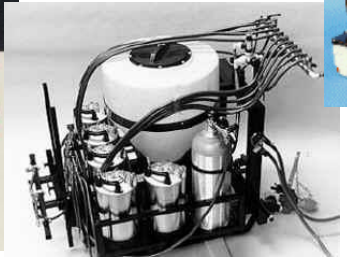
Foggers

5 μm Fogger



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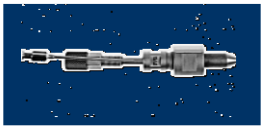
Compressed Air System Components

Compressed Air Charging System

Atomizing Nozzles



Atomizing Nozzle

Compressed Air Cylinders

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Portable Spray System

A self-contained portable spray system

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Mobile Systems

Car-mounted compressor

Car-mounted compressed air tank

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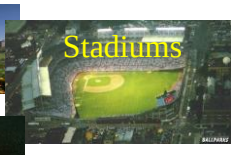
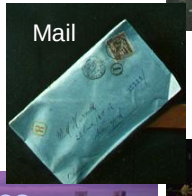
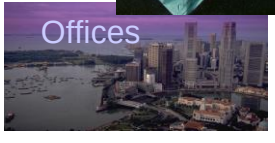
Threat Scenarios

- Open areas
- Buildings
- Food sources
- Mail
- Water supply





Restaurants



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Threats in Open Areas

- Aerosols
  - Sprayers, foggers
  - Explosive dispersal
- Resuspension
  - Area “dusting”
- Enhanced by
  - Wind
  - Movement of vehicles, people, etc.

Threats in Buildings

- Aerosols/gases
  - Ventilation systems
- Explosive dispersal
  - Collateral damage
  - Loss of covert/clandestine characteristics
- Dusting
  - Resuspension
  - Secondary ingestion

Threats in Food Service

- Grocery
  - Produce
- Food processing
  - Meat packing
  - Produce

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Food Born Contamination

Salad bars and other buffet facilities can be easily contaminated

Spray Bottles

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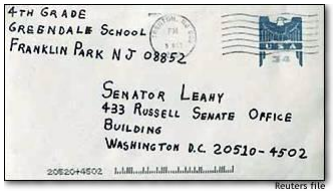
Threats in the Mail

- Dusting
  - Resuspension of dry BTA
  - Secondary ingestion
- Explosive
- Common non-credible threat mechanism



Reuters file

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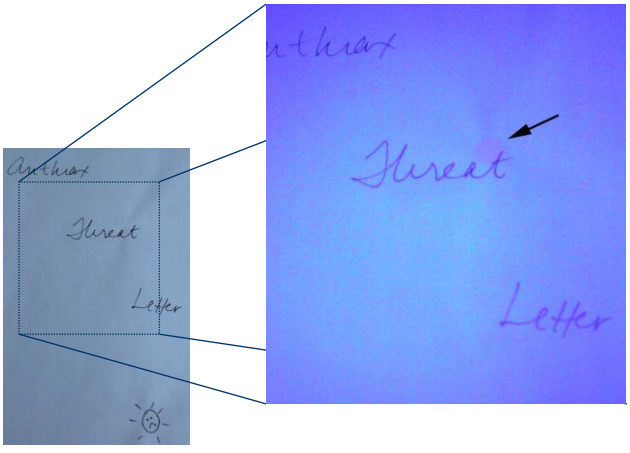
Bt Spores on a Letter



Spores visible under UV light

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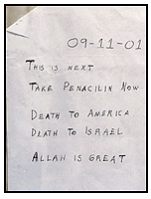
Daschle Letter



- Letter contained 2 g (0.07 oz) of Anthrax spores
- Approximately 20,000,000,000 spores
- Infective dose is 8,000 to 50,000
- 2,000,000 infective doses (of 10,000 spores) in Daschle letter
- Four deaths to date (10/31/01)

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What About Our Water?

- Could someone contaminate the source of our water?
- Would this contamination make it to the consumers?
- Where are there risks in our supply systems?

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Water System Components

- Water works
  - Source water
    - Ground water
    - Surface water
  - Treatment for potability
    - Pathogens
    - Poisons
- Water distribution
  - Prevent posttreatment contamination of potable water
  - Water storage
  - Delivery to consumers

Water works and water distribution work together to provide potable water to consumers

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Source Water Contamination

- Successful reservoir contamination may be difficult
  - Dilution
  - Subsequent water works will remove or significantly reduce the effectiveness of most agents
- Perception not proportional to threat level

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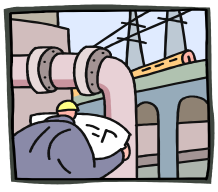
Water Works Contamination

- Successful contamination with agents at a water works facility may also be difficult
  - Dilution
  - Controlled access
  - Treatment in-progress will reduce or eliminate agent effectiveness



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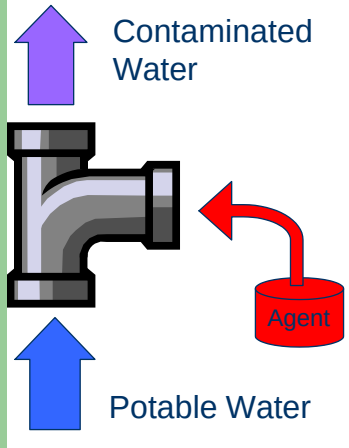
Distribution System Contamination



- Cross-connection and backflow
- Common distribution problem is perfect for introduction of agents

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Goal III: Learning Objectives

1) Know the routes of entry for chemical and biological threats
2) Know the 3 most common signs of a nerve agent exposure
3) Know the difference between the symptoms of a nerve agent exposure and a vesicant exposure

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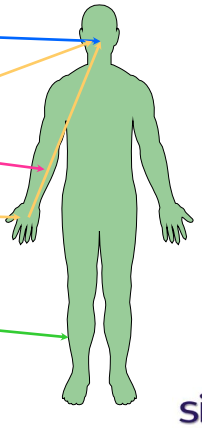
How do Chemical and Biological Agents get to a Body?

- Inhalation
  - Liquid aerosols
  - Dry aerosols
  - Gases/vapors
- Absorption
  - Dermal
  - Mucosal
- Ingestion
  - Food/water contamination
  - Fomites (dust, skin flakes, etc.)
- Injection
  - Percutaneous
  - Insects
  - Pests



Routes of Entry

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Symptoms of Inhaled Nerve Agent

- Low-dose
  - Contracted pupils (miosis)
  - Runny nose (rhinorrhea)
  - Mild breathing difficulty

- High-dose
  - Unconsciousness
  - Convulsions
  - Temporary/transient breathing stoppages (apnea)
  - Limp (flaccid paralysis)
  - Drooling (copious secretions)
  - Contracted pupils (miosis)

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Symptoms of Adsorbed Nerve Agent

- Low-dose
  - Localized sweating
  - Localized muscle twitching
  - Nausea
  - Vomiting
  - Weakness
- High-dose
  - Unconsciousness
  - Convulsions
  - Suspended breathing
  - Limpness
  - Drooling

Immediate Decontamination is Required

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Symptoms of Blister Agent Exposure

- Inhaled
  - Hoarseness
  - Hacking cough
  - Runny/bloody nose
  - Sneezing
  - Respiratory difficulty
- Adsorbed
  - Reddening of the skin
  - Swollen spots on skin
  - Blisters
  - Tearing of the eyes
  - Itching/burning eyes

Symptoms May Not Be Observed for Hours to Days!

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Mustard Injuries

Iranian Soldier with 2-week Old Mustard Injuries

Baltic Fisherman with "Fresh" Mustard Bullea and Vesicles

Mortality From Vesicants is Usually Caused by Lung/Pulmonary Damage

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Symptoms of Biological Agent Diseases

Anthrax	Fever, malaise, fatigue, cough, and chest discomfort
Cholera	Vomiting, abdominal distention and pain with little or no fever are followed rapidly by a profuse, watery diarrhea
Plague	Fever, malaise, headache, tender lymph nodes, and blood poisoning,
Tularemia	Fever, malaise, and headache, cough, abdominal pain

Note the similar early symptoms for many of the diseases

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Symptoms of Biological Agent Diseases, cont'd

Botulism	Weakness, dizziness, dry mouth and throat, blurred vision, followed by paralysis, loss of tendon reflexes and impaired muscle
Smallpox	Malaise, fever, rigors, vomiting, headache, and backache, skin lesions appear and progress centrifugally
Ricin	Fever, cough, difficulty breathing, nausea, and chest tightness, followed by sweating, the development of pulmonary edema, blood poisoning, and hypotension

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Goal IV: Learning Objectives

1) Recite the 6-step response protocol for a potential hazardous materials event
2) Place in order the most likely SBLE hazardous materials event classes
3) Recognize the differences in response protocols based on observations in a student population

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What if Biological Agents are Suspected at the Scene?

- Few biological agents will cause immediate harm
- In the field:
  - Minimize spread of potential contamination
    - Stay out of the scene unless immediate aid/rescue is needed
  - Isolate potential victims
- Effects from exposure can usually be prevented with subsequent medical care
- Limited medical care can be done in the field

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If You Suspect a *Chemical*, *Biological*, or *Radiological* Hazard:

1 OBSERVE
- Unusual Smells
- Unusual Noises
- Lack of Insects (Unusually Quiet)
- Wind Direction/Source
- Waste Materials/Placards
- Sprayers/Devices
- Masks/Gloves/Aprons
- Secondary Devices
- Liquids/Powders/Mists

2 ASSESS
- Notify Dispatch/Others
- Immediate Personal Danger
- Plume Location and Direction
- Casualties (From Distance)
- Danger of Entering Scene
- Need for Other Resources

3 PLAN
- Scene Entry
- Exit Strategy
- Backup
- Precautions
  - Protective Equipment

4 COMMUNICATE
- To Casualties on Scene
- To Dispatcher
  - Scene Assessment
  - Perimeter Control
  - Technical Assistance
- To Civilian Responders

5 RESPOND
- Secure
  - Crime Scene
  - Hazardous Perimeter
- Observe
- Look for Symptoms
- First Aid

DECON

En Route and Before Entering the Scene...

Observe

- Unusual smells
- Unusual noises
- Lack of insects (unusually quiet)
- Wind direction/source
- Waste materials/placards
- Sprayers/devices
- Masks/gloves/aprons
- Secondary devices
- Liquids/powders/mists

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Use your observations to...

Assess

- Need to notify dispatch and other immediately
- Immediate Personal Danger
- Plume Location and Direction
- Casualties
  - From a Distance
- Danger of Entering a Scene
- Need for Additional Resources

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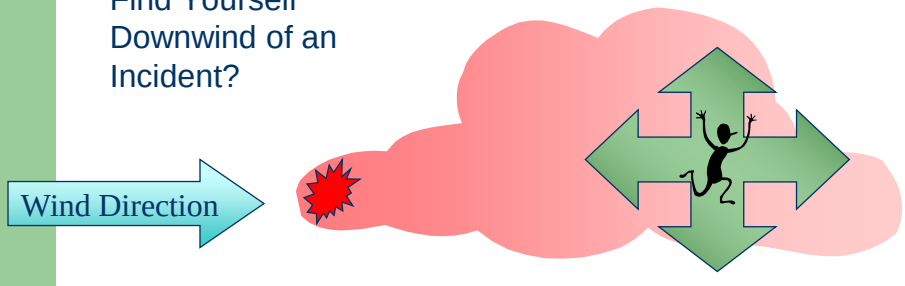
Just in Case...

- What Do You Do If You Find Yourself Downwind of an Incident?



Which Way do You Go?

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Based on Your Assessment...

Plan

- Scene entry
  - What is the safest route into the scene?
- Exit strategy
  - How am I going to get out--in a hurry?
- Backup
  - Should backup be present before I enter the scene?
- Precautions
  - Gloves
  - Other PPE?

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Make you plan known...

Communicate

- To dispatcher
  - Scene assessment
  - Perimeter control
  - Technical assistance
- To casualties on the scene
- To civilian responders

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And Then…

Respond

- Secure
  - Crime scene
  - Hazardous perimeter
- Observe
  - Continue to look for hazard indicators
- Look for symptoms in you, partner, and victims
- Carefully provide first aid

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Before Leaving the Scene…

Decontaminate

- Seek technical assistance for proper decontamination
- Failure to decontaminate properly can spread agents

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	Agent	Name	Odor	Symptoms	Field Response
Nerve	GA	Tabun	Fruity	**Vapor Exposure** Small pupils, Runny Nose, Shortness of Breath, Apnea, Drooling, Limpness, Convulsions **Skin Exposure** Localized Sweating, Nausea, Twitching,	End the Exposure (Decon or Remove from Area) Administer 1-3 MARK 1 Kits (AtroPen: Atropine) (ComboPen: Pralidoxime Chloride)
	GB	Sarin	None		
	GD	Soman	Fruity		
	VX	-	None		
Blister	H, HD, HN, HS	Mustard	Garlic/Mustard	**Vapor Exposure** Burning Eyes, Cough, Shortness of Breath, Bloody Nose, Hoarseness **Skin Exposure** Skin Reddening, Skin Swelling, Blisters, Burning	End the Exposure (Decon or Remove from Area) Decontamination within 1 or 2 minutes of exposure will minimize effects
	L	Lewisite	Geraniums		
	CX	Phosgene Oxime	Irritating		
	Agent	**Disease**	**Contagious**	**Onset/Symptoms**	**Field Response**
Bacteria	*Bacillus anthracis*	Anthrax (Pulmonary)	No	1-6 days/Fever, Fatigue, Cough	Decontamination
	Yersinia pestis	Plague (Pneumonic)	Yes	1-6 days/Fever, Cough, Headache	Isolation, Decontamination
	Francisella tularensis	Tularemia	No	2-10 days/Fever, Fatigue, Headache	Decontamination
	Brucella	Brucellosis	Yes (Low)	3-21 days/Fever, Fatigue	Decontamination
	Coxiella burnetii	Q Fever	Yes (Low)	10-20 days/None or Variable	Decontamination
Viruses	Variola major	Smallpox	Yes (High)	8-18 days/Fever, Vomiting, Rash	Isolation, Decontamination
	Viral Encephalitides	Encephalitis	Yes (Low)	1-7 days/Fever, Confusion, Variable	Decontamination
	Viral Hemorrhagic Fevers	Hemorrhagic Fevers	Yes (Low)	2-35 days/Shock, Bleeding	Decontamination

Immediate Antidote (Autoinjectors) and decontamination	Urgent Isolation and decontamination
Urgent Decontamination	Decontamination

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What are First Responders Most Likely to Encounter?

1. **Threats** to public and infrastructure
   - Near-term emphasis in chemical and biological
2. **Conventional** terrorist tools
3. **Toxic industrial chemical** incidents
4. **Chemical incidents**
5. **Biological incidents**
   - Most likely to show up in the health care system
   - MET/CMT
6. **Radiological/nuclear** events are very unlikely

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Quick Exercises

- Divide into groups
- Review the scenario
  - Each group will have a different scenario
- Discuss the observations that SBLE should make
- Discuss the response you would organize if the threat turns into an event at your school

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Summary

- Be aware of the signs and symptoms of a chemical incident
- Most biological agents will **not** immediately incapacitate a first responder
- Protect yourself so you can be a part of the solution

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