

Science and Technology for NPTS



Chemistry Segment Instructor: Mark Bishop

“If...in the future wars we are to avoid gross mismanagement in high places and panic...among the masses, it is essential that everyone should learn elementary science, and that politicians and soldiers should not be proud of their ignorance of it...”

J. B. S. Haldane

Scenario



- You're working for the state department.
- American troops in Syria have been attacked by what appears to be a chemical agent.
- Because it's known that you have some knowledge of chemical weapons, you've been invited to a meeting where the attempts are made to answer a variety of questions, including the following.
 - *What do you think the chemical was? How can that be determined?*
 - *Who were the likely attackers?*

Questions Relating to These attacks

- What are the most common chemical weapons?
- How does one determine that they were used?
- What are the symptoms of exposure?
- What are their physiological effects in the body?
- How quickly do they act?
- How deadly are they?
- What are the treatments for exposure?
- How are they dispersed?
- Are they hard to make? Is it hard to get the necessary ingredients (precursors)?
- Are they difficult to transport?

What chemical weapons have already been used in Syria?

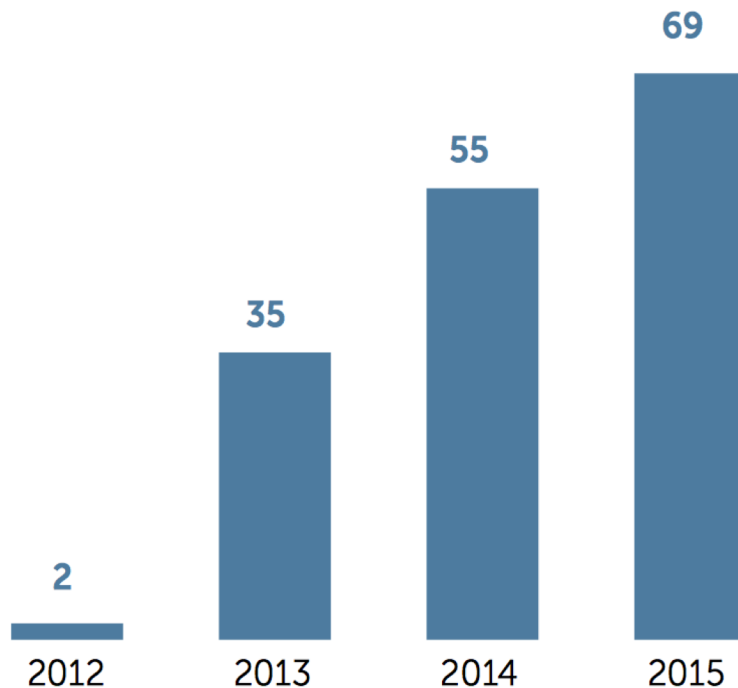
- Syrian American Medical Society, a charity that runs 95 medical facilities inside the country, reported the following.
 - Nearly 200 chemical attacks since 2012
 - Used reports and first-hand accounts from physicians and health workers in Syria.
 - By 2015, documented chemical attacks led to at least 1,491 deaths and 14,581 injuries from chemical exposure.

<http://www.sams-usa.net/reports/a-new-normal-ongoing-chemical-weapons-attacks-in-syria/>

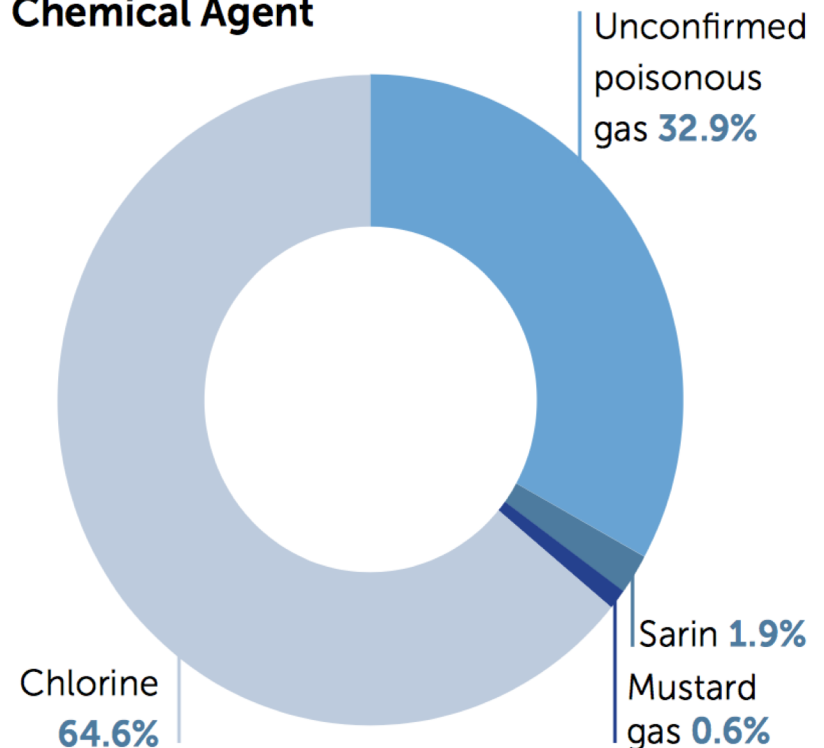
https://www.sams-usa.net/press_release/sams-syria-civil-defense-condemn-chemical-attack-douma/

From Syrian American Medical Society

Attacks by Year



Chemical Agent



OPCW-UN Fact-Finding Missions (FFM) and Joint Investigative Mechanism (JIM)

- Described the investigations and results of eight cases of possible use of chlorine or a chlorine derivative and one related to the use of sulfur mustard in Syria.
- Reported that there were three incidents where there was either a substance “matching the characteristics of chlorine”, “a canister with traces of chlorine or a chlorine-like substance”, “a significant number of people — up to 150 — may have been exposed to chlorine” and a “canister with traces of chlorine”.
- Two cases with a “toxic substance” used.
- They reported one incident where “there was sufficient information to conclude that Islamic State in Iraq and the Levant (ISIL) was the only entity with the ability, capability, motive and means to use sulfur mustard in Marea on 21 August 2015”.
- For the other incidents, they were unable to confirm the use of chemical weapons.

https://www.un.org/ga/search/view_doc.asp?symbol=S/2016/738

OPCW-UN JIM Report



- One goal is to help you understand and evaluate important documents, such as the Third Report of the Organization for the Prohibition of Chemical Weapons-United Nations Joint Investigative Mechanism relating to the use of chemical weapons in Syria.

https://www.un.org/ga/search/view_doc.asp?symbol=S/2016/738

VX Attack on Kim Jong-nam

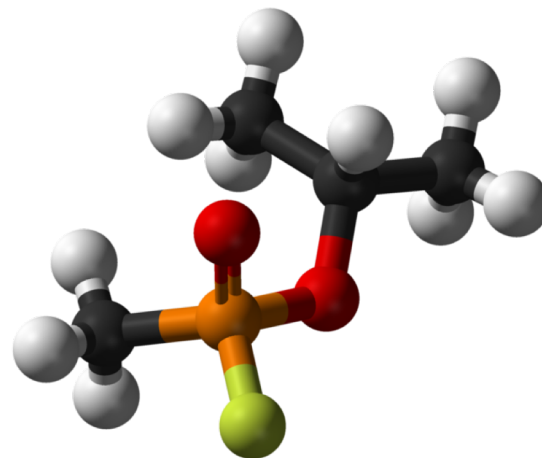
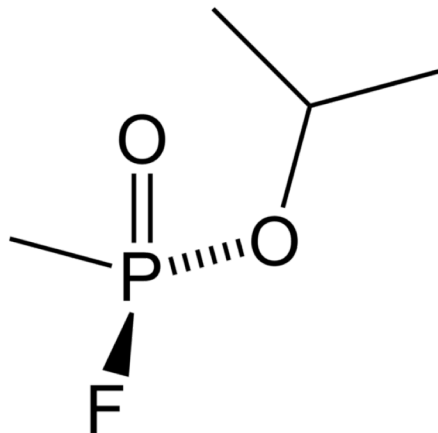


- 13 February 2017 - Kim Jong-nam killed in the Kuala Lumpur International Airport in Malaysia
- Eldest son of Kim Jong-il
- Half brother of Kim Jong-un
- Two women are thought to have attacked him with the nerve agent VX
- Widely believed to have been ordered by the North Korean government

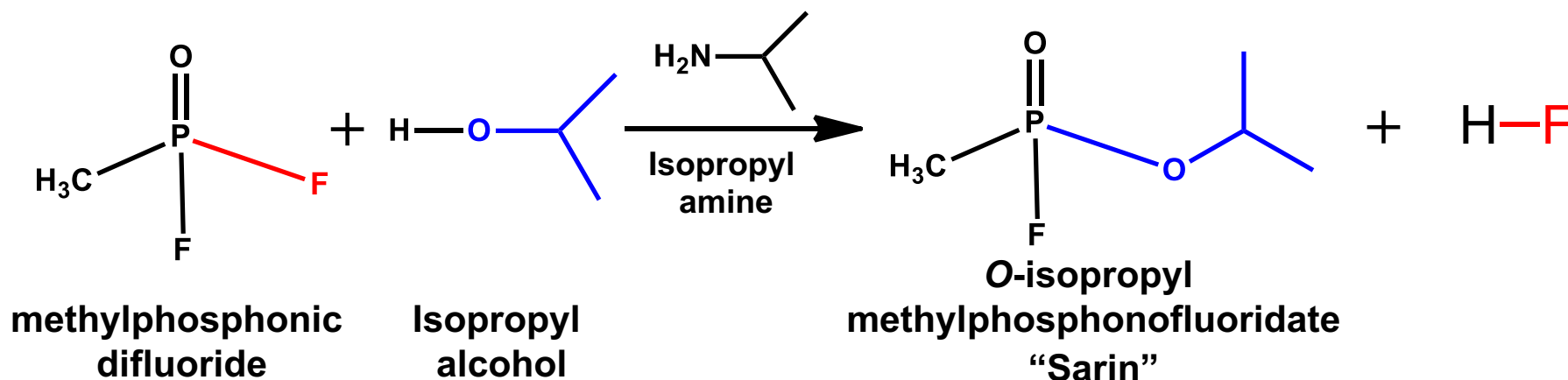
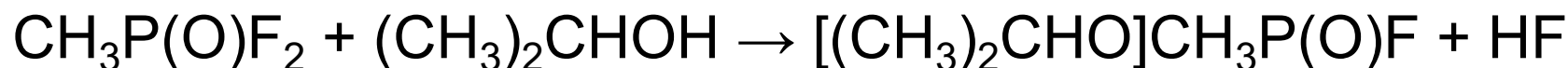
Questions Relating to VX Attack on Kim Jong-nam

- Why might there have been two women who touched Kim Jong-nam's face?
- Why weren't the two women significantly affected?
- Why weren't the other people in the airport and in emergency vehicle affected?
- Is North Korea thought to have VX and other chemical weapons?
- Are there restrictions for making, stockpiling, and using chemical weapons?
- Do these restrictions apply to North Korea?

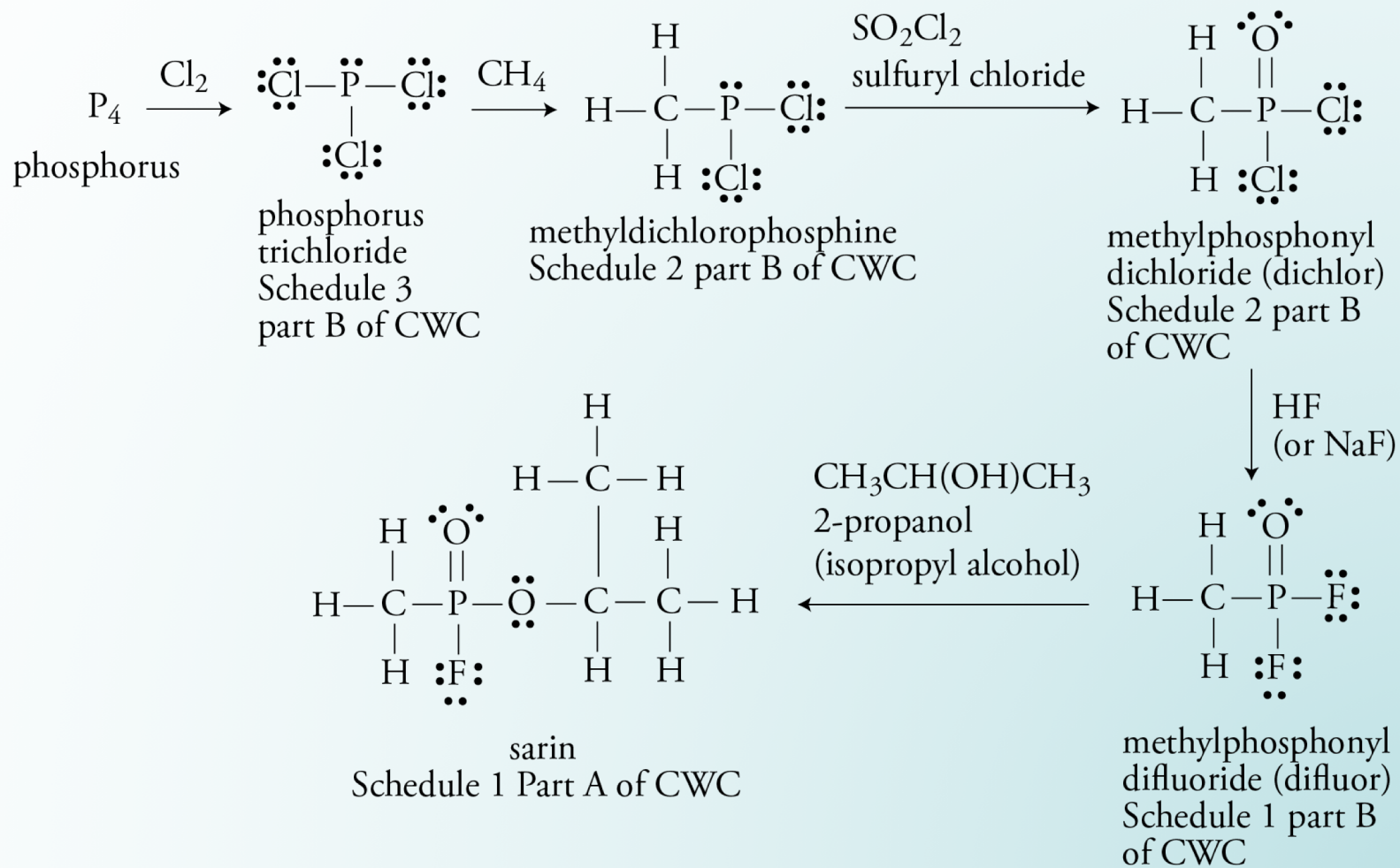
Sarin (GB)



- Most easily prepared from methylphosphonyl difluoride and isopropyl alcohol.



Rough Possible Steps for Production of Sarin



Sarin (GB)

- A very large amount of sarin has been made, but very little of it has been used.
 - March 1988 - Iraq used against Kurd city of Halabja
 - April 1988 – Iraq against Iran.
 - 3/20/1995 - Used in the Tokyo Subway attack by Aum Shinrikyo
 - 8/21/2013 – Ghouta, Syria
 - 4/4/2017 – Khan Shaykhun, Syria
 - 4/7/2018 – Douma, Syria

Russia's Novichok



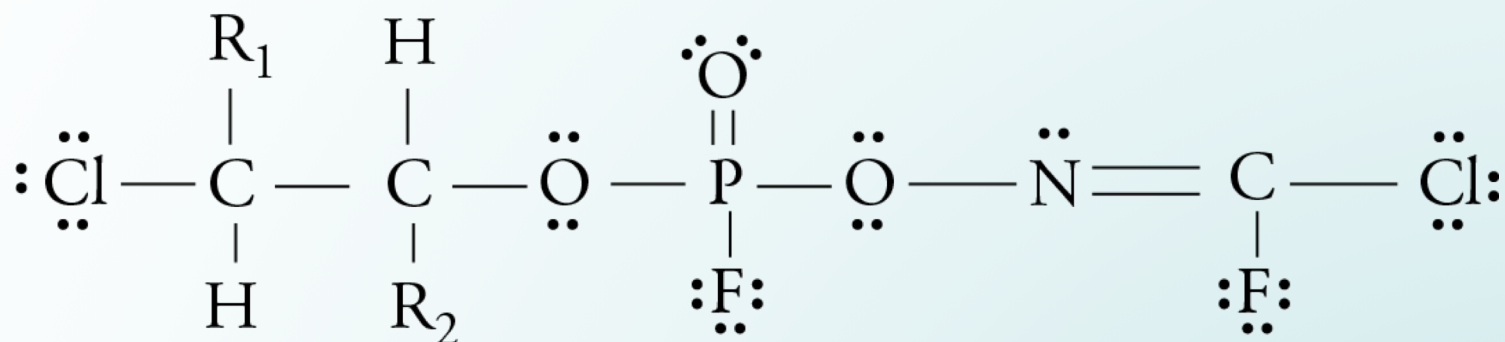
- A-234 thought to be used in the Salisbury, UK attack on the former Russian military intelligence (GRU) officer Sergei Skripal and his daughter Yulia.
- Czech Republic admitted to making a small quantity of A-230.
- In 2016, Iranian scientists produced five Novichok agents and generated mass spectral data that makes identifying Novichoks easier.

Russia's Novichok



- Alleged Soviet secret program called Foliant
- Novichok (new guy or newcomer) – a category of nerve agents developed in the 1970s and 1980s
- Intent was to develop binary agents that could be made from relatively safe substances similar to normal industrial substances, making it easier to conceal the production
- Allegedly more lethal than VX
- Resistant to treatment

Russia's Novichok



- A230 – $R_1=H$ and $R_2=H$
- A232 – $R_1=H$ and $R_2=CH_3$
- A234 – $R_1=CH_3$ and $R_2=CH_3$

Assignment



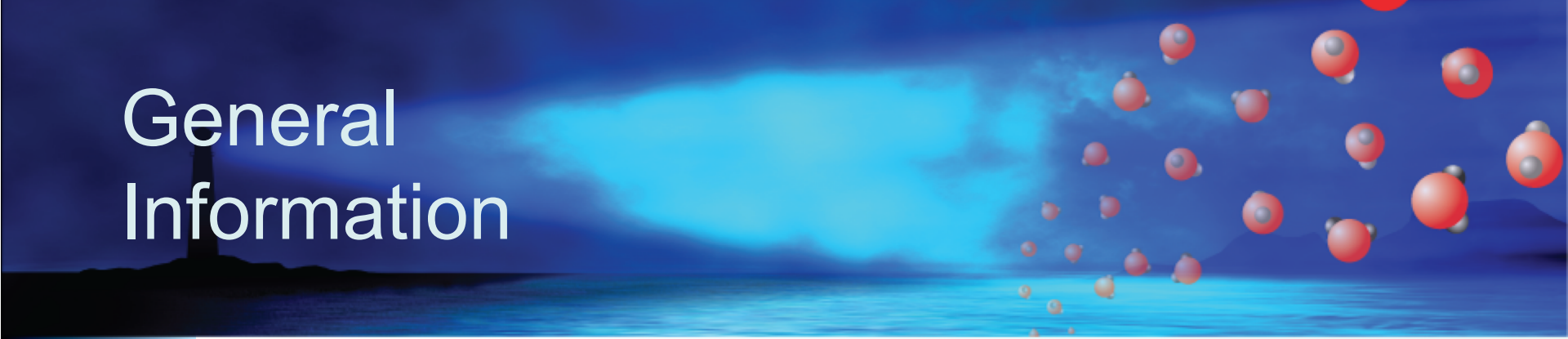
- This will begin after the fourth chemistry module lecture.
- You will divide yourselves into groups of four.
- Two people in each group will pretend to be either *terrorists* or a country's *military leaders* and plan a simulated chemical weapons attack...choosing the target, the chemical weapon, the means of dispersal, the source of the chemical weapon, and the means of transporting the chemicals.
- Two people in each group will act as the *security team* attempting to stop the attack.

Assignment



- The *terrorists* or *military leaders* will provide subtle clues to the *security people*.
- The *security pair* can tell the *terrorists* what they are looking for, and the *terrorists* will provide clues based on these searches.
- Based on the clues they have received, the security team will develop a plan to stop the attack, and failing that, a plan to minimize the effects of the attack.
- Each group of four will make a 5-minute presentation describing their experience.

General Information



Email

mbishop@chiralphublishingcompany.com

mbishop@miis.edu

Web Sites

<http://preparatorychemistry.com>

[http://institutebishop.org/science technology.htm](http://institutebishop.org/science_technology.htm)

Recommended Reading



- *An Introduction to Chemistry – Atoms First* by Mark Bishop

http://preparatorychemistry.com/Bishop_Atoms_First.htm

- *War of Nerves – Chemical Warfare from World War I to Al-Qaeda* by Jonathan B. Tucker ISBN 978-1-4000-3233-4

First Week Reading

- **An Introduction to Chemistry - Atoms First**
 - Measurement and Units - Section 1.4 (pages 9-19 of Chapter 1)
 - Scientific notation - Appendix B (pages A-4 and A-5)
 - Solids, liquids and gases – Section 3.1 (pages 76-79 of Chapter 3)
 - Chemical Elements - Section 3.2 (pages 80-83 of Chapter 3)
 - Periodic table - Section 3.3 (pages 84-87 of Chapter 3)
 - Elements and atoms (pages 87-92 of Chapter 3)

http://preparatorychemistry.com/Appendix_B_atoms.pdf

http://preparatorychemistry.com/Bishop_Book_atoms_1.pdf

http://preparatorychemistry.com/Bishop_Book_atoms_3.pdf

First Week Reading

- **An Introduction to Chemistry - Atoms First**
 - Energy (pages 120-131 of Chapter 4)
 - Modern Atomic Theory (Just to get the basic ideas) (pages 132-145 of Chapter 4)
 - Chemical bonds (pages 175-179 of Chapter 5)
 - Classifying Compounds (page 180 of Chapter 5)

http://preparatorychemistry.com/Bishop_Book_atoms_4.pdf

http://preparatorychemistry.com/Bishop_Book_atoms_5.pdf