

BSC MythBusters:

Can I use UV or any chemical as a disinfectant in my BSC?



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BSC MythBusters

- There are a lot of rules, “guidelines”, rumors, and myths for using a Biosafety Cabinet.
- Which are true?
- Which are not?
- WHY?



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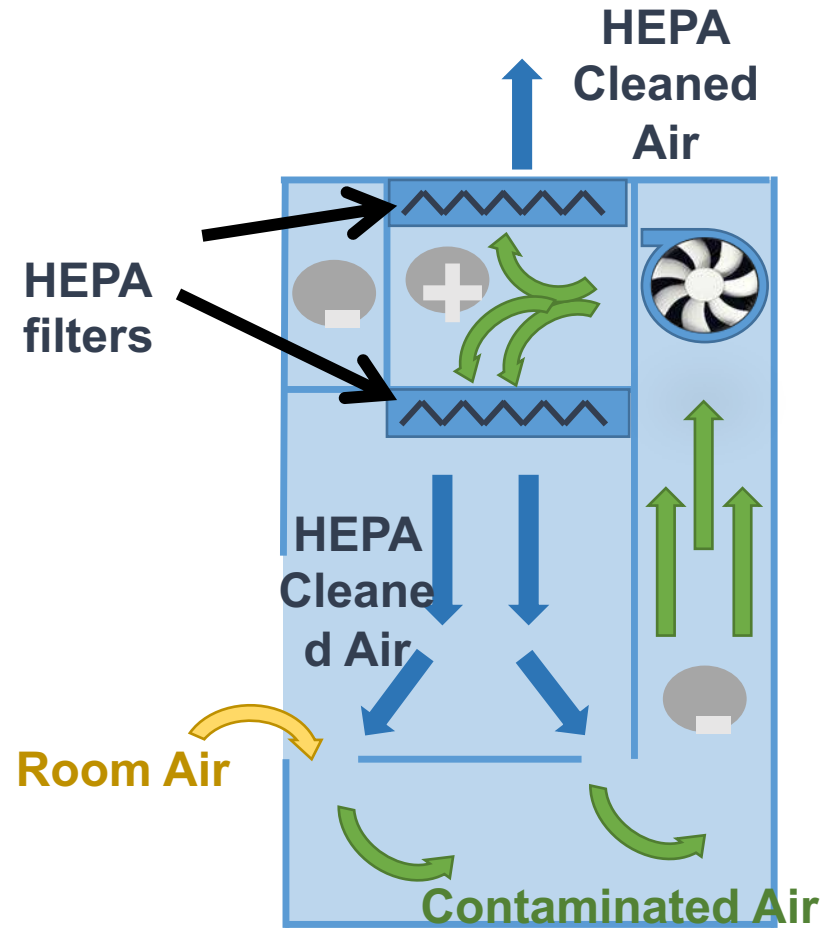
*Baker is not affiliated with this TV show!

Biosafety Cabinets (BSCs)

- A ventilated enclosure for work with biohazard agents assigned to biosafety levels 1 through 4.
- Provides 3 types of CONTAINMENT:
 - Personnel protection
 - Product protection
 - Environmental protection
- All BSCs contain 1+ HEPA filters & motor/blower



Class II Type A2 BSCs



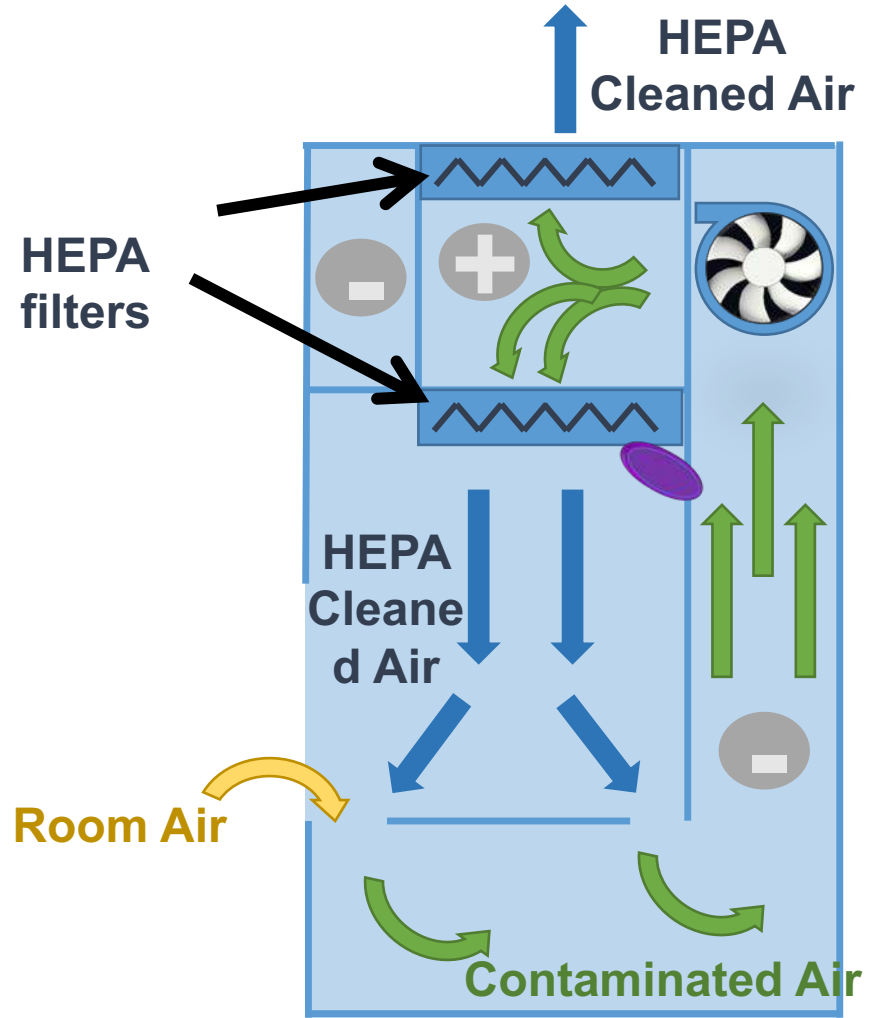
- Personnel, Product and, Environmental Protection from particulates and aerosols.
- Minimum 100 fpm intake air
- Partial recirculation

Normal BSC Operation



1. Strong front intake air
2. Side suction slots
3. Downward HEPA filtered air
4. Smoke split to front and back
5. Momentum Air Curtain

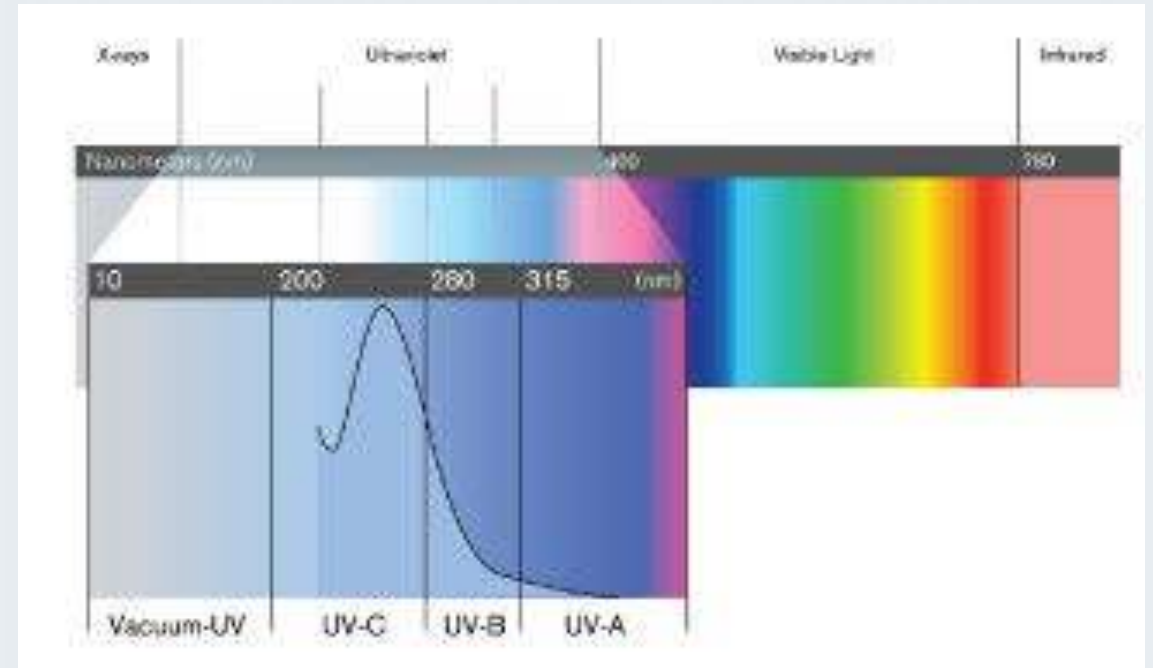
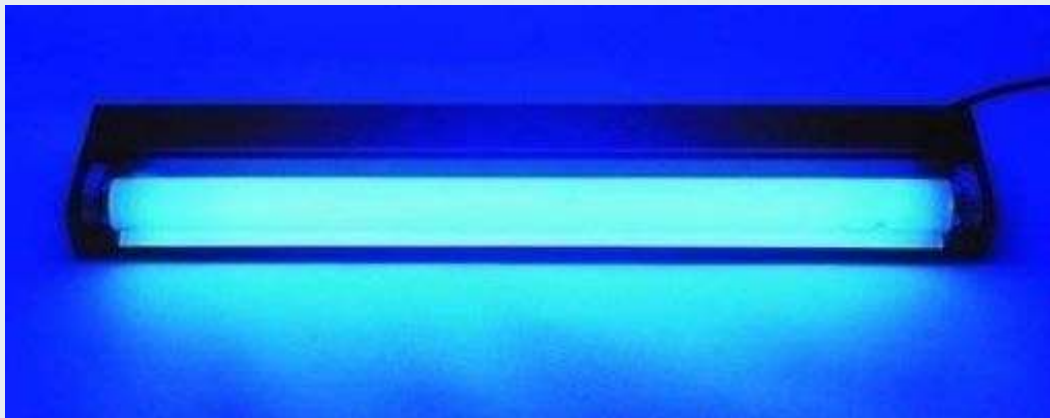
MYTH: UV Light is an Effective Disinfectant



- Theoretical reasoning:
 - Many industries use UV light as a disinfectant
 - Water systems
 - Food
 - Air
 - Wastewater systems
 - Hospitals
 - It comes built into the BSC! Why not use it?
 - “I can disinfect in between users!”

How does a UV Lamp Work?

- UV lamps in BSCs use short-wave UV-C (254nm) irradiation to kill microorganisms by disrupting their DNA
- Requires intensity and time to be effective
- Not ideal for moving air
- Dust and films on the bulb lower intensity



What do the resources say?

BMBL

Ultraviolet Lamps

Ultraviolet (UV) lamps are **not recommended in BSCs nor are they necessary**. If installed, UV lamps must be cleaned weekly to remove any dust and dirt that may block the germicidal effectiveness of the ultraviolet light. The lamps should be checked weekly with a UV meter to ensure that the appropriate intensity of UV light is being emitted. UV lamps must be turned off when the room is occupied to protect eyes and skin from UV exposure, which can burn the cornea and cause skin cancer. If the cabinet has a sliding sash, close the sash when operating the UV lamp.

UV Lamp Test: A few BSCs have UV lamps. When used, they must be tested periodically to ensure that their energy output is sufficient to kill microorganisms. The surface on the bulb should be cleaned with 70% ethanol prior to performing this test. Five minutes after the lamp has been turned on, the sensor of the UV meter is placed in the center of the work surface. The radiation output should not be less than 40 microwatts per square centimeter at a wavelength of 254 nanometers (nm).

What do the resources say?

NSF/ANSI Standard 49

5.27.2 UV lighting

UV lighting is **not recommended in Class II (laminar flow) BSCs**. If requested by the purchaser, it shall be installed in such a manner that it does not reduce the required performance as specified in Section 6. This Standard does not provide any performance verification of UV lighting.

E.3.3.3 Ultraviolet lighting

Germicidal (or UV) lamps are often installed **as an adjunct to surface disinfection**. **UV lighting is not recommended in BSCs**. While their usefulness is a subject for debate among users and manufacturers, they should be installed and tested by the manufacturer during assembly of the unit.

Experimental Methodology

Class II Type A2 BSC

A 4 foot SterilGARD BSC with an 8" sash opening was balanced and disinfected with 70% ethanol prior to beginning work and in between experiments.

New UV bulb

A brand-new UV bulb was installed into the BSC, with output wattage measuring at least 380 $\mu\text{W}/\text{cm}^2$, well above the minimum requirement of 40 $\mu\text{W}/\text{cm}^2$.

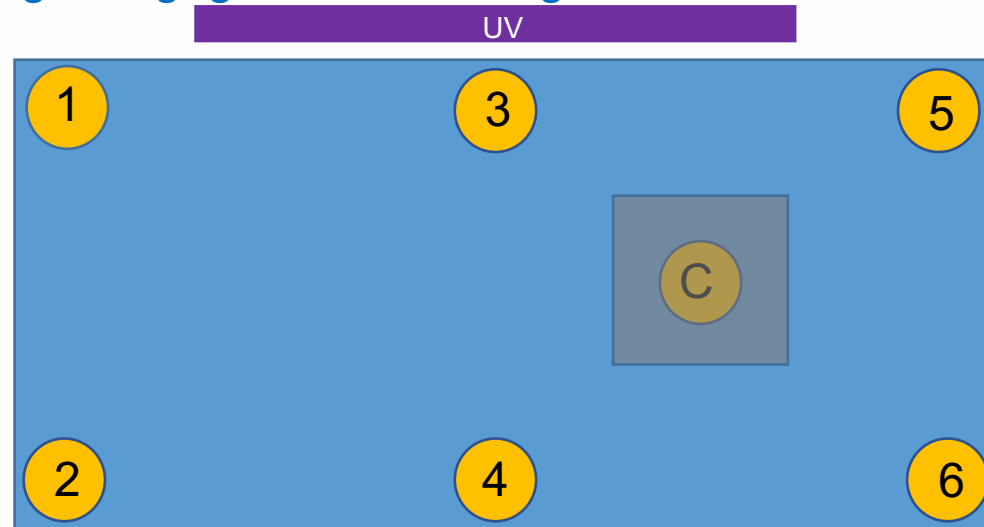
Bacteria

Escherichia coli K12 (PTA-7555, ATCC) was grown on Tryptic Soy Agar plates.

Experimental Methodology

Experiment set up

Petri dishes inoculated identically with E.coli were arranged as depicted on the work surface of the BSC. The control plate was shadowed with aluminum foil. The sash was closed, BSC entered ReadySAFE low flow mode, and the UV light engaged for the designated timeframe.



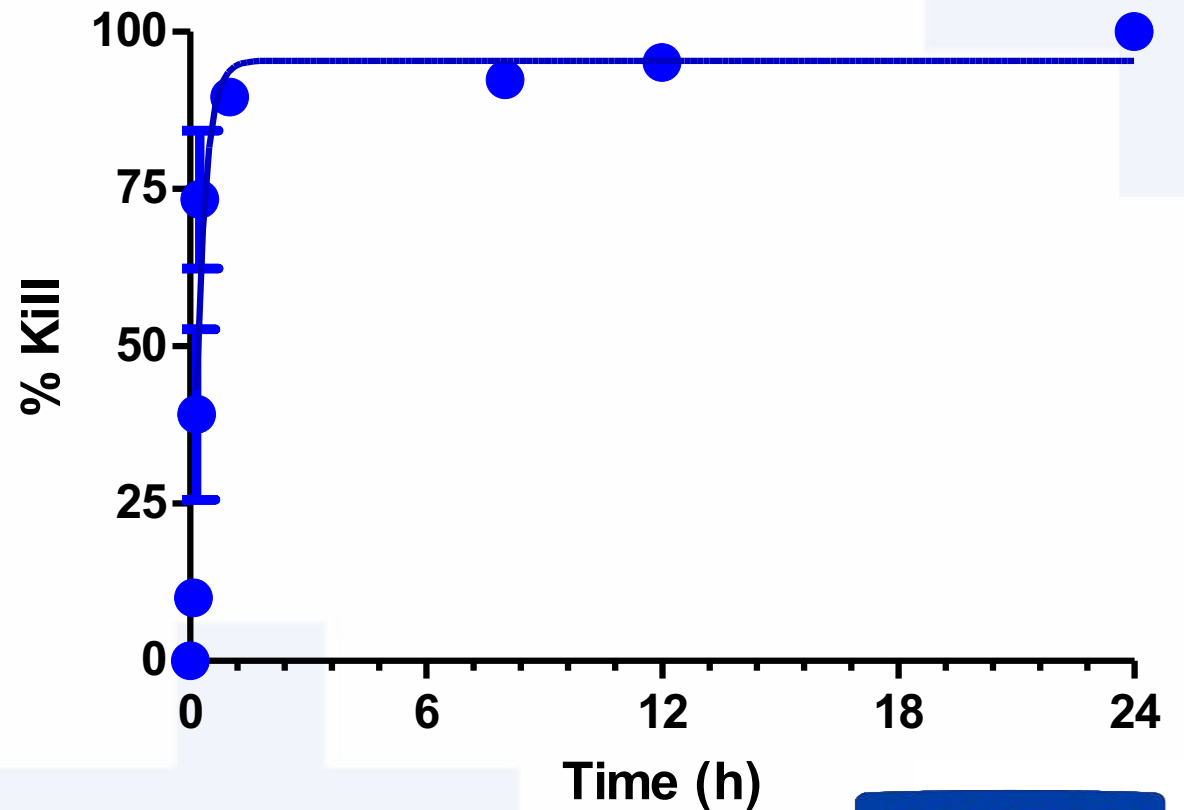
Experiment timing

A full set of plates were run for each timepoint: 0 min, 5 min, 10 min, 15 min, 1 hour, 8 hours, 12 hours, 24 hours.

UV light effectiveness over time

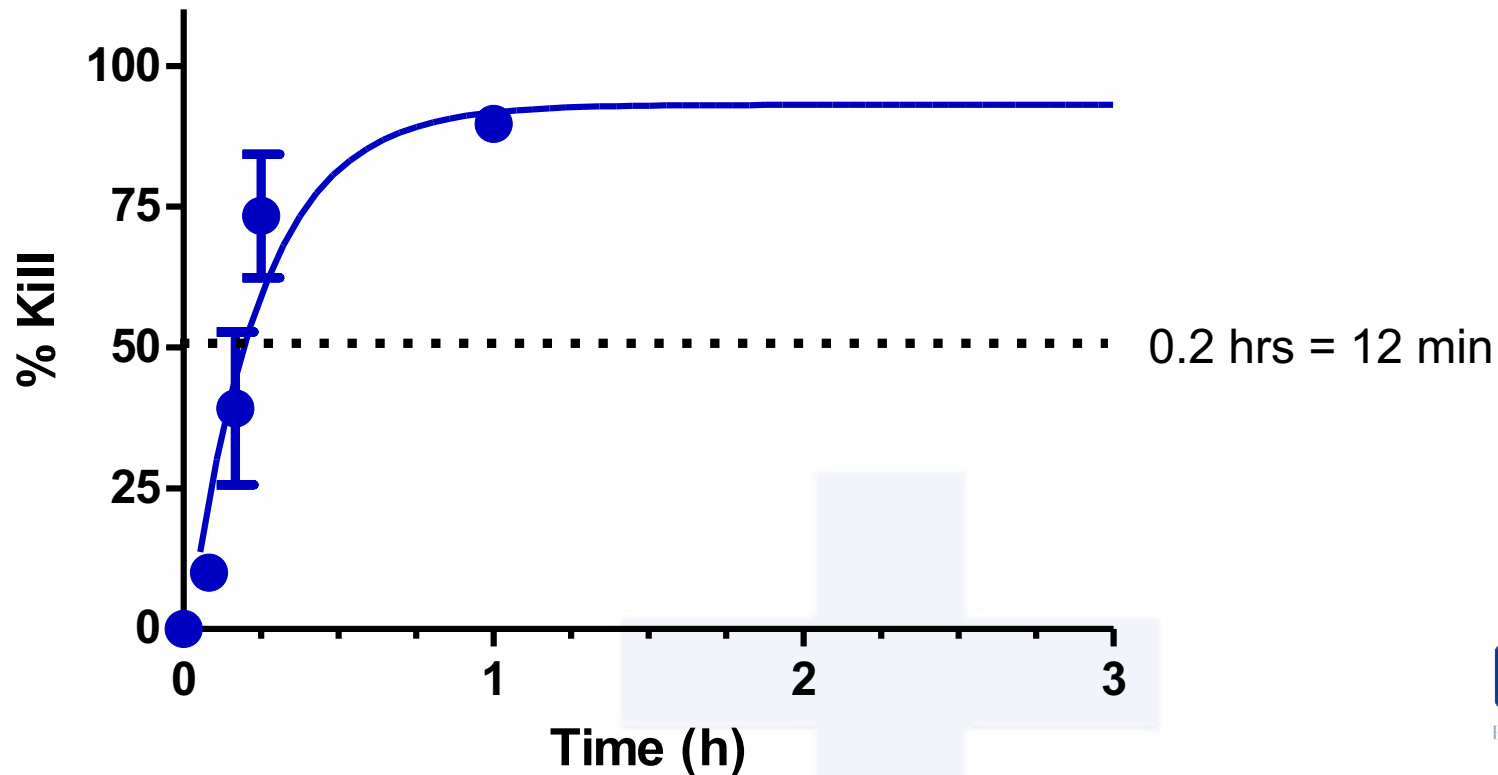
The longer the bacteria were exposed to UV, the more effective the kill.

Time	Average Kill
0 min	0%
5 min	10%
10 min	39%
15 min	73%
1 hour	90%
8 hours	92%
12 hours	95%
24 hours	100%



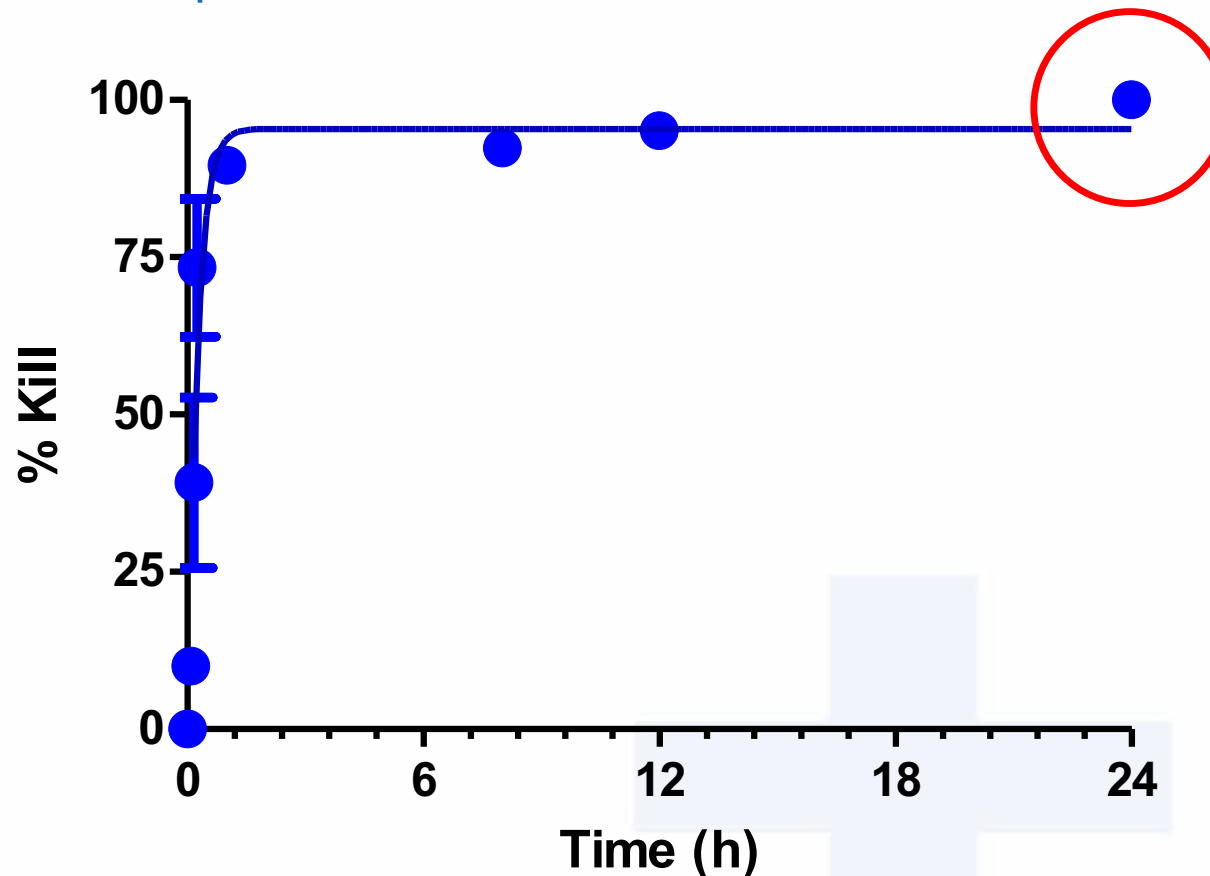
Determining LD₅₀

From a logarithmic graph like this, we can determine the LD₅₀, or how long the “Lethal Dose” of UV is for 50% of the bacteria.



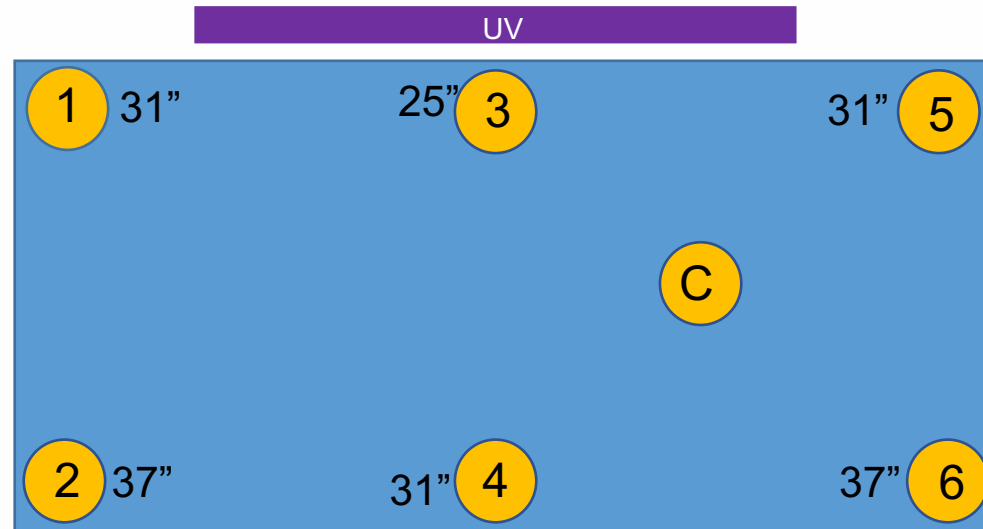
Kill a lot quickly, but not all...

While the initial impacts of UV are seen within the first hour, complete kill does not occur until 24 hours of continued exposure.



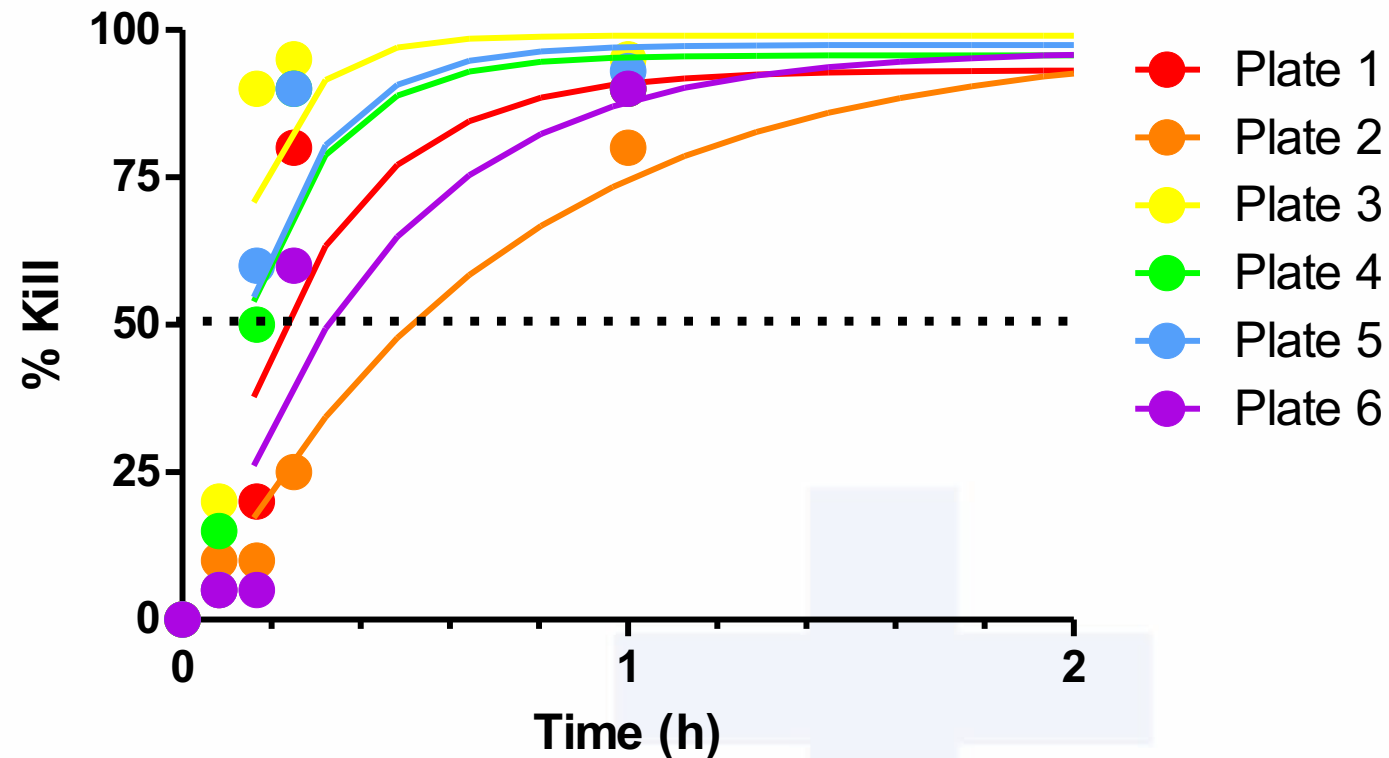
Effectiveness of UV is dependent on no obstructions, time, and distance

Our 4ft BSC was completely empty except for the petri dishes and UV bulb. The distance to each plate was measured from the center of the UV bulb.



Does distance from the UV change its effectiveness?

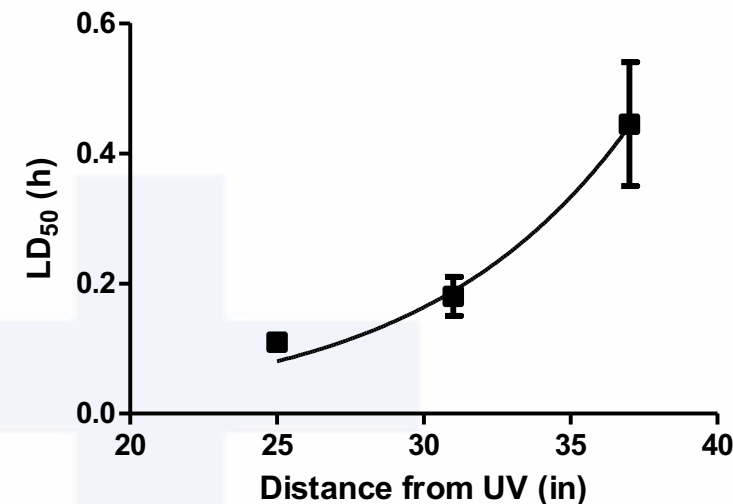
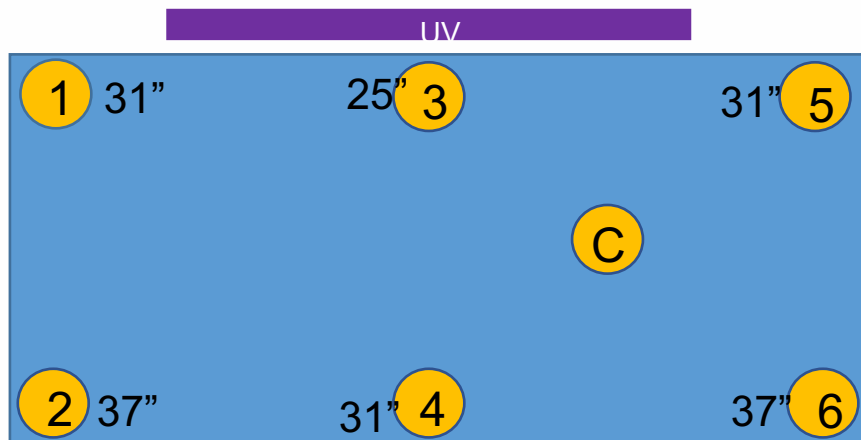
Plates from each location were plotted separately to determine their own individual LD₅₀s.



Distance is directly correlative to the effectiveness of kill

The longer the distance from the UV bulb, the longer it takes to kill.

Plate #	1	2	3	4	5	6
Distance from UV center	31"	37"	25"	31"	31"	37"
LD ₅₀ (h)	0.24	0.54	0.11	0.15	0.15	0.35
LD ₅₀ (min)	14	32	7	9	9	21



MYTH: UV light is an effective disinfectant

IF all criteria are met:

- New bulb with at least 40 $\mu\text{W}/\text{cm}^2$ of intensity of the work surface
- No shadowing anywhere
- Clean bulb, no dust or films present
- Proper time allowed to accumulate
- Periodic checks to ensure effective kill

RECOMMENDATION:

Since this is unlikely, UV should only be used as a secondary method of disinfection, best coupled with a chemical disinfectant.



BSC MythBusters:

Can I use any chemical disinfectant in my BSC?



MYTH: Any chemical disinfectant is appropriate to use in my BSC

- Theoretical reasoning: Most BSCs are made of stainless steel, so they can resist anything. Why make a disinfectant that will ruin a solid surface?



Chemical and Material Compatibility

- Each chemical that makes up a disinfectant can interact with different materials.
- The chemical composition must be taken into consideration one chemical at a time.



What is the difference between 304 and 316 stainless steel?

- 304 is made up of 18% chromium and 8% nickel
- 316 is made up of 16% chromium, 10% nickel and 2% molybdenum.
- The molybdenum helps resist corrosion to chlorides.

Most BSCs are made of 304 SS
316 SS is preferred for heavy cleaning protocols.

Common Disinfecting Agents vs. Steel

Chemical	304 SS	316 SS
Water, Distilled	A	A
Water, Deionized	A	A
Water, Fresh	A	A
Ethanol	A	A
Isopropyl Alcohol (70%)	B	B
Iodophor	A	A
Sodium Hypochlorite (<20%)	C	C
Sodium Hypochlorite (100%)	D	D
Citric Acid	B	A
DECON-QUAT®	C	B
Peridox®	B	B
Vesphene™	B	B
Vesphene Environ®	D	B
LpH® III se	D	B
EcoLab® disinfectant cleaner	C	B
Iodine	D	D

Ratings Key	
A	Excellent
B	Good: Minor Effect, slight corrosion, or discoloration
C	Fair: Moderate Effect, not recommended for continuous use. Softening or loss of strength and swelling may occur
D	Severe Effect: Not recommended for any use

Ratings B-D require a sterile water or ethanol rinse to remove chemical residue.



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MYTH: Any chemical disinfectant is appropriate to use in my BSC

- Not all chemicals work well on stainless steel
- Depends on the grade of steel (304 vs. 316 SS)
- All agents except A rated chemicals need a sterile water or ethanol rinse to remove chemical residue.



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COMMON DISINFECTANT CHEMICAL COMPATIBILITY WITH STAINLESS STEEL



THERE ARE A LOT OF RULES, 'GUIDELINES', RUMORS AND MYTHS FOR USING A BIOSAFETY CABINET. WE'LL BE EXPLORING:



WITH
KARA HELD Ph.D.
BAKER SCIENCE DIRECTOR



WHICH
ARE TRUE?

WHICH
ARE NOT?

WHY?

IF YOU HAVE A BSC
MYTH THAT COULD
USE TESTING, SEND
IT TO US! WE'LL GET
SOME ANSWERS

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Common Disinfectant Chemical Compatibility with Stainless Steel

Not all disinfectants are appropriate for all microorganisms you'd like to kill, and the same goes for the surface they are applied to. Some chemicals can stain, pit, and/or rust your stainless steel surface of your Biosafety Cabinet (BSC) with repeated use, leaving a hard to clean work surface. Here's a handy chart of commonly used cleaners and their compatibility with 304 and 316 Stainless Steel. As a rule of thumb, all chemicals rated B-D if used, should be followed up with a sterile rinse of a Category A chemical such as sterile water or alcohol to protect your steel. The brand name cleaners referenced are commonly used in pharmacy applications.



Chemical	Ratings	
	304 SS	316 SS
Water, Distilled	A	A
Water, Deionized	A	A
Water, Fresh	A	A
Ethanol	A	A
Iodophor	A	A
Isopropyl Alcohol (70%)	B	B
Sodium Hypochlorite (< 20%)	C	C
Sodium Hypochlorite (100%)	D	D
Citric Acid	B	A
DECON-QUAT®	C	B
Peridax®	B	B
Vesphene®	B	B
Vesphene Environ®	D	B
LpH® III se	D	B
EcoLab® disinfectant cleaner	C	B
Iodine	D	D

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RATINGS KEY

- A Excellent
- B Good: Minor Effect, slight corrosion, or discoloration
- C Fair: Moderate Effect, not recommended for continuous use, Softening or loss of strength, and swelling may occur
- D Severe Effect: Not recommended for any use
- E Information not available

Reference: Corrosion-Resistant Chemical Compatibility Database www.corrosionresistant.com/corrosion-resistance

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BSC Mythbusters

<https://bakerco.com/communication/bsc-mythbusters/>

- Can you use volatile chemicals in a Class II Type A2 Recirculating BSC?
- Does heat really affect my protection?
- Can HEPA's filter out everything?



COMING SOON:

- Can you overload a BSC?
- Can 2+ people work in a BSC at the same time?





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