**Use of Disinfectants During a Pandemic**

**STANDARD OPERATING PROCEDURE (SOP)**

**Type of SOP:** ☐ Process/Equipment ☒ Hazardous Chemical ☐ Hazardous Class

**All personnel who are subject to these SOP requirements must review a completed SOP and sign the associated training record. Completed SOPs must be kept with the UC Davis Laboratory Safety Manual or be otherwise readily accessible to laboratory personnel. Electronic access is acceptable. SOPs must be reviewed, and revised where needed, as described in the** [**UC Davis Laboratory Safety Manual**](http://safetyservices.ucdavis.edu/article/laboratory-safety-manual)**. The unique properties of each chemical must be considered when preparing a SOP.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Date SOP Written: | | **5/5/20** | |  | Approval Date: | | | **5/6/20** |
| SOP Prepared by: | | **Dennis Cocherell** | | | | | | |
| **CLSC SOP Task Force** | | | | | | |
| SOP Reviewed and Approved by (name/signature): | | | | **Daniel Karp**A necklace on a black background  Description automatically generated | | | | |
| Department: | | **Wildlife, Fish, and Conservation Biology** | | | |
| Principal Investigator/ Laboratory Supervisor: | | **Daniel Karp** | | | | Phone: | **530 219 9868** | | |
| Lab Manager/  Safety Coordinator: | | **Daniel Karp** | | | | Phone: | **530 219 9868** | | |
| Emergency Contact(s): | | **Christine Crum** | | | | Phone: | **530-219-8136** | | |
|  | |  | | | |  |  | | |
|  | |  | | | |  |  | | |
|  | |  | | | |  |  | | |
|  | |  | | | |  |  | | |
| Location(s) covered by SOP: | Building: | | **Academic Surge** | | | Lab Phone: | **n/a** | | |
| Room #(s): | | **Academic Surge** | | |

1. **HAZARD OVERVIEW**

When working during a pandemic and sharing common spaces, work areas must be disinfected. Disinfectants can also be hazardous chemicals, and usually are. Lists of disinfectants that are effective against Covid-19 are available on the EPA website (epa.gov). The list of disinfectants is long and some of the formulations are proprietary. Consult the manufacturer’s Safety Data Sheet (SDS) of the proprietary disinfectant for its list of hazards. The list of hazardous chemicals below represent the most common active ingredients in disinfectants that might be used during a pandemic within common lab spaces.

1. **HAZARDOUS CHEMICAL(S)/CLASS OF HAZARDOUS CHEMICAL(S)**
2. **Quaternary Ammonium Compounds (QACs)**

These compounds are found in various forms such as benzalkonium chloride, benzethonium chloride, methylbenzethonium chloride, cetalkonium chloride, cetylpyridinium chloride, cetrimonium, cetrimide, dofanium chloride, tetraethylammonium bromide, didecyldimethylammonium chloride and domiphen bromide (see <https://en.wikipedia.org/wiki/Quaternary_ammonium_cation> for more info). Some forms are not considered antimicrobial.

The hazards associated with QACs commonly used in aquatic vivarium range from skin irritation to death, as well as QACs being a possible reproductive toxin. The amount of hazard associated with a product is a result of both the QAC itself and the dilution of the QAC in the proprietary solution. Please carefully read the SDS of your proprietary solution and the instructions for use to minimize hazards. Generally QACs, even when diluted, have a long shelf life.

QACs are beneficial in the treatment of porous surfaces (i.e. wood, clothing, etc.) and they are not generally corrosive to metal. However, they can be deactivated in the presence of common soaps. The residuals will also most likely stay on surfaces unless removed by washing with soap/water. Depending on the formulation of your product, it may or may not act as a cleaning agent, areas that are not clean cannot usually be disinfected. The amount of time that a surface has to stay in contact with a QAC in order to disinfect varies according to its formulation, read the instructions of your formulation for how much time you should leave it.

1. **Ethanol (EtOH)**

In general, ethanol is effective in killing microorganisms. It does so by dissolving the membrane lipid bilayer and denaturing their proteins, and is effective against most bacteria, fungi and viruses. 70% ethanol is the most effective concentration, particularly because of osmotic pressure. Absolute ethanol may inactivate microbes without destroying them because the alcohol is unable to fully permeate the microbe's membrane. Here is the link for EtOH information from Wikipedia: <https://en.wikipedia.org/wiki/Ethanol>. Use of flammable liquids requires a lab specific SOP.

Ethanol is a highly flammable volatile liquid. Be careful where you use it as a disinfectant, as you can set the laboratory on fire. It is an irritant to the skin and can be fatal if swallowed. Generally, diluted ethanol has a 3-6 month shelf life.

70% ethanol requires a 10 minute contact time for killing. As the surface dries, you must reapply. There is no residual left by ethanol, other than that left by the diluent (i.e. water). A higher concentration of ethanol is not better. A higher concentration sometimes leads to the drying of the thing you are trying to kill, but not the killing. The pathogen can sometimes still be active when it rehydrates.

1. **Isopropanol (IPA)**

Isopropanol, or Isopropyl alcohol, is effective in killing microorganisms. It works with the same mechanisms as ethanol. It is also highly flammable, use of flammable liquids requires a lab specific SOP, it is not as volatile as ethanol. It is an irritant and can cause drowsiness/dizziness if the fumes are inhaled. Here is the link for the Sigma IPA SDS: <https://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=US&language=en&productNumber=I9516&brand=SIGMA&PageToGoToURL=https%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fsearch%3Fterm%3Dipa%26interface%3DAll%26N%3D0%26mode%3Dmatch%2520partialmax%26lang%3Den%26region%3DUS%26focus%3Dproduct>

It should be used in a 70-75% solution in water to act as a disinfectant, with a contact time of 10 minutes. As the surface dries, you must reapply, although it dries more slowly than ethanol. A higher concentration of IPA is not better. A higher concentration sometimes leads to the drying of the thing you are trying to kill, but not the killing. The pathogen can sometimes still be active when it rehydrates. Generally, diluted IPA has a 3-6 month shelf-life.

1. **Bleach (sodium hypochlorite)**

Bleach is a great disinfectant. You must use bleach that contains sodium hypochlorite as its active ingredient. This is because it is the chlorine that is released that does the killing. Bleach will also remove color from all fabrics, etc. and is quite corrosive to metal. It is a strong oxidizer, so be careful where you use it for chemical compatibility. Bleach will react with dishwashing soap, which sometimes contains ammonia, to make chloramine gas, which is toxic. Bleach will react with acids (including vinegar) to release chlorine gas, again highly toxic. Bleach itself is toxic and an irritant. Take all appropriate PPE precautions. Here is the link to the SDS for Clorox household bleach: <https://www.thecloroxcompany.com/wp-content/uploads/cloroxregular-bleach12015-06-12.pdf>

Household bleach is sold as a 3-6% solution of sodium hypochlorite in water. You then take that solution and dilute it further to 1 part bleach to 4 parts water for use as a disinfectant. The contact time is 10 minutes for a good disinfection. It is best if you follow up the disinfection with a wipe of clean water to remove the residue. Diluted bleach has a shelf-life of hours or minutes. The diluted bleach is best used immediately if you wish to use it as a disinfectant. Sunlight (or UV) will deactivate diluted bleach very quickly.

1. **Virkon S Broad Spectrum Disinfectant**

Virkon S is a disinfectant used against disease-causing organisms with a focus on viral pathogens. Virkon S comes as a yellow powder and should be mixed with water at appropriate dilution rates for the type of disinfecting that will take place. When mixing, wear protective gloves and eye/face protection. Use in a well-ventilated area and avoid breathing dust. Wash hands thoroughly after handling. The following are incompatible materials and should not be used with Virkon S: strong bases, combustible material, acids, oxidizers, brass, copper, halogenated compounds, cyanides, and heavy metal compounds. When used with incompatible materials, Virkon S may release sulfur dioxide or chlorine as hazardous decomposition products. Do not use or store near heat or open flame. Here is the SDS for Virkon S: <https://syndel.com/wp-content/uploads/2019/01/Virkon-S-SDS.pdf>

For routine disinfection for all surfaces, a dilution rate of 1:400 should be used. For example, 2.5 grams of Virkon S should be weighed out and added to 1 liter of water; stir thoroughly to dissolve. The solution should be applied to surfaces using a spray bottle. Allow minimum contact time of 30 minutes and leave to dry.

1. **Mold Armor Mold Remover & Disinfectant**

Mold Armor kills 99.9% of household bacteria and viruses, however it is very toxic to aquatic organisms so be mindful when disinfecting and keep away from all fish and fish equipment. It is an irritant to humans, so use in a well ventilated area and avoid major skin contact with the product. Do not mix with oxidizers, anionic soaps, and detergents. When used with incompatible materials, Mold Armor may release carbon monoxide, carbon dioxide, and toxic hydrogen chloride vapors. Do not use or store near heat or open flame. Here is the SDS for Mold Armor: <https://images.homedepot-static.com/catalog/pdfImages/4b/4b2fa318-2e66-4227-8314-89a243d55dfd.pdf>

To use, spray Mold Armor onto common surfaces and allow to remain wet for 10 minutes, then allow to air dry or wipe.

1. **ENGINEERING/VENTILATION CONTROLS**

Disinfectants, if used as directed, should not require engineering or ventilation controls. When preparing flammable material proper PPE’s should be used (e.g. flame resistant lab coat, safety glasses, and gloves).

1. **ADMINISTRATIVE CONTROLS**

The following elements are required:

1. Complete the [UC Laboratory Safety Fundamentals](http://safetyservices.ucdavis.edu/training/uc-laboratory-safety-fundamentals) (or approved equivalent) training prior to working in the laboratory;
2. Complete laboratory-specific safety orientation and training on laboratory-specific safety equipment, procedures, and techniques to be used, including any applicable laboratory-specific Laboratory Safety Plan(s), prior to receiving unescorted access to the laboratory;
3. Demonstrate competency to perform the procedures to the Principal Investigator (PI), Laboratory Supervisor, laboratory-specific Safety Officer, and/or trainer;
4. Be familiar with the location and content of any applicable Safety Data Sheets (SDSs) for the chemicals to be used (online SDSs can be accessed from [UC SDS](http://ucsds.com));
5. Implement good laboratory practices, including good workspace hygiene;
6. Inspect all equipment and experimental setups prior to use;
7. Follow best practices for the movement, handling, and storage of hazardous chemicals (see Chapters 5 and 6 of [Prudent Practices in the Laboratory](http://ucanr.edu/sites/ucehs/files/133892.pdf) for more detail). An appropriate spill cleanup kit must be located in the laboratory. Chemical and hazardous waste storage must follow an appropriate segregation scheme and include appropriate labeling. Hazardous chemical waste must be properly labelled, stored in closed containers, in secondary containment, and in a designated location;
8. Do not deviate from the instructions described in this SOP without prior discussion and approval from the PI and/or Laboratory Supervisor;
9. Notify the PI or Laboratory Supervisor of any accidents, incidents, near-misses, or upset condition (*e.g.,* unexpected rise or drop in temperature, color or phase change, evolution of gas) involving the process, hazardous chemical(s), or hazardous chemical class described in this SOP; and
10. Abide by the laboratory-specific working alone SOP, if applicable.
11. A discussion with the PI or lab manager is required before performing disinfection of laboratory surfaces. Some disinfectants will destroy laboratory equipment, or harm the person doing the disinfecting if used in the wrong concentrations.
12. Personnel who get sick with Covid-19 (or suspect they are sick with Covid-19) should **notify their immediate supervisor, who will then notify the chair and the CAO**. The notification should be anonymous to comply with medical confidentiality. The lab should be closed immediately, signage posted for no entry (not that there was a Covid-19 case) and campus cleaning services will be initiated. All personnel that have been in contact with the person or the lab should self-quarantine until testing can be done to confirm Covid-19. Deep disinfection of the lab upon receipt of a positive test for Covid-19 will be done by a vendor that has been contracted by UC Davis. Instances of possible or suspected COVID-19 cases on campus should be communicated to custodial services as early as possible so that those spaces can be thoroughly cleaned. Additionally, if a confirmed case of COVID-19 is identified, an outside vendor will be contracted to clean that space
13. Watch a video on handwashingand demonstrate competency. A video that you might use is here: <https://youtu.be/IisgnbMfKvI>
14. Watch a video on glove removaland demonstrate competency. A video that you might use is here: <https://www.youtube.com/watch?v=BOAb_cy3HxM&feature=youtu.be>
15. **PERSONAL PROTECTIVE EQUIPMENT (PPE)**

At a minimum, long pants (covered legs) and closed toe/closed heel shoes (covered feet) are required to enter a laboratory or technical area where hazardous chemicals are used or stored.

In addition to the minimum attire required upon entering a laboratory, the following PPE is required for all work with hazardous chemicals:

1. Eye Protection:
   1. Eye protection must be ANSI Z87.1-compliant.
   2. At a minimum safety glasses are necessary.
   3. Splash goggles may be substituted for safety glasses, and are required for processes where splashes are foreseeable or when generating aerosols.
   4. Ordinary prescription glasses will NOT provide adequate protection unless they also meet the Z87.1 standard and have compliant side shields.
2. Body Protection: At a minimum a chemically-compatible laboratory coat that fully extends to the wrist is necessary.
   1. If a risk of fire exists, a flame-resistant laboratory coat that is NFPA 2112-compliant should be worn.
   2. For chemicals that are corrosive and/or toxic by skin contact/absorption additional protective clothing (*e.g.,* face shield, chemically-resistant apron, disposable sleeves, etc.) are required where splashes or skin contact is foreseeable.
3. Hand Protection: Hand protection is needed for the activities described in this SOP. Define the type of glove to be used based on the following:
   1. Chemical(s) being used;
   2. Anticipated chemical contact (e.g. incidental, immersion, etc.);
   3. Manufacturers’ permeation/compatibility data; and
   4. Whether a combination of different gloves is needed for any specific procedural step or task.

PPE and hygiene practices should adhere to the directions found on the bottle of disinfectant. Be aware that Cal/OSHA has not relaxed the “fit-testing” requirement for the wearing of N95 masks for work. For more information about fit-testing from employee health please look here: https://safetyservices.ucdavis.edu/safetynet/the-respiratory-program.

1. **SPILL AND EMERGENCY PROCEDURES**

Follow the guidance for chemical spill cleanup from [SafetyNet #13](http://safetyservices.ucdavis.edu/safetynet/guidelines-chemical-spill-control) and/or the [UC Davis Laboratory Safety Manual](http://safetyservices.ucdavis.edu/article/laboratory-safety-manual), unless specialized cleanup procedures are described below. Emergency procedure instructions for the UC Davis campus and UCD Medical Center are contained in the [UC Davis Laboratory Safety Manual](http://safetyservices.ucdavis.edu/article/laboratory-safety-manual), [campus Emergency Response Guide (ERG)](http://safetyservices.ucdavis.edu/sites/default/files/documents/Emergency_Response_Guide.pdf), and [UCD Health System ERG](http://www.ucdmc.ucdavis.edu/medresearch/downloads/labsafety/2.6-UCDHS-Emergency-Response-Guide.pdf). The applicable ERG must be posted in the laboratory. All other locations must describe detailed emergency procedure instructions below.

Note that ethanol and IPA are extremely flammable. Use caution in spill cleanup to not ignite.

Note that all of these disinfectants release some sort of fume. These fumes can be as minor as an irritant or as major as a toxic gas. Know what you are doing before cleaning up a spill and consider if you need to call for outside help. Please consult the SDS for your chemical solution to find the best practices for emergency procedures and spill clean-up.

1. **WASTE MANAGEMENT AND DECONTAMINATION**

Hazardous waste must be managed according to [Safety Net #8](http://safetyservices.ucdavis.edu/safetynet/guidelines-disposal-chemical-waste), and must be [properly labeled](http://safetyservices.ucdavis.edu/article/hazardous-waste-storage-and-labeling). In general, hazardous waste must be removed from your laboratory within 9 months of the accumulation start date; refer to the [accumulation time for waste disposal to ensure compliance](http://safetyservices.ucdavis.edu/article/hazardous-waste-storage-and-labeling). Hazardous waste pick up requests must be completed using [WASTe](https://ehs.ucop.edu/waste/#/).

**Note:** See the [WASTe Factsheet](http://safetyservices.ucdavis.edu/sites/default/files/documents/WASTe_Factsheet.pdf) for instructions on how to complete a label.

There probably will be no waste streams generated. Storage of disinfectants should follow the directions on the label. There should not be any special handling/storage requirements except for bleach, which should not be stored next to acids or other incompatibles.

Upon completion of work with hazardous chemicals and/or decontamination of equipment, remove gloves and/or PPE properly and wash hands and arms with soap and water. Additionally, upon leaving a designated hazardous chemical work area, remove all PPE worn and wash hands, forearms, face and neck as needed. Contaminated clothing or PPE should not be worn outside the lab. Soiled lab coats should be sent for professional laundering. Grossly contaminated clothing/PPE and disposable gloves must not be reused.

Upon completion of work with hazardous chemicals and/or decontamination of equipment, remove gloves and/or PPE to wash hands and arms with soap and water. Additionally, upon leaving a designated hazardous chemical work area remove all PPE worn and wash hands, forearms, face and neck as needed. Contaminated clothing or PPE should not be worn outside the lab. Soiled lab coats should be sent for professional laundering. Grossly contaminated clothing/PPE and disposable gloves must not be reused.

1. **DESIGNATED AREA**

The entire laboratory, fumehoods, and a portion of the labs could have disinfectants used in or around it. Care must be taken to follow the manufactures or EPA use recommendations. Disinfectants should be stored and labeled safely; At CABA, Academic Surge, and Hydraulics lab have designated spaces on the counter tops for in-use disinfectants. During the pandemic frequently disinfected surfaces are label with a card denoting its daily disinfecting, the Vivarium care logs at each facility have lines for if disinfecting has occurred. If you’re concerned or unsure consult the log book for verification of disinfection of common surfaces; including door handles, key, locks, counter tops, etc.

1. **DETAILED PROTOCOL**

Manufacture use recommendation should always be followed for the safe use of disinfecting products.

**TEMPLATE REVISION HISTORY**

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date Approved** | **Author** | **Revision Notes:** |
| **1.0** | **12/1/2014** | **CLSC Task Force** | **New template** |
| **1.1** | **4/16/2015** | **Chris Jakober** | **Changed SDS link, language relating to soiled PPE** |
| **1.2** | **5/11/2016** | **Chris Jakober** | **Updated URLs following website redesign, added URL to UCDHS ERG** |
| **1.3** | **11/30/2016** | **Lindy Gervin** | **Unlocked editable fields** |
| **1.4** | **3/13/2017** | **Lindy Gervin** | **Updated links in section 7 to WASTe system** |
| **1.5** | **12/6/2017** | **Chris Jakober** | **Reformatted hand protection PPE language, added “Equipment” into SOP category type checkbox.** |

**LAB-SPECIFIC REVISION HISTORY**

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date Approved** | **Author** | **Revision Notes:** |
| **V2** | 5/5/2020 | **Dennis Cocherell** | New SOP designated |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Documentation of Standard Operating Procedure Training**

*(Signature of all users is required)*

* Prior to using **Use of Disinfectants during a Pandemic**, laboratory personnel must be trained on the hazards involved in working with this SOP, how to protect themselves from the hazards, and emergency procedures.
* Ready access to this SOP and to a Safety Data Sheet for each hazardous material described in the SOP must be made available.
* The Principal Investigator (PI), or the Laboratory Supervisor if the activity does not involve a PI, must ensure that their laboratory personnel have attended appropriate laboratory safety training or refresher training within the last three years.
* Training must be repeated following **any** revision to the content of this SOP. Training must be documented. This training sheet is provided as one option; other forms of training documentation (including electronic) are acceptable but records must be accessible and immediately available upon request.

A necklace on a black background

Description automatically generated

**Designated Trainer:** *(signature is required)* Daniel Karp

I have read and acknowledge the contents, requirements, and responsibilities outlined in this SOP:

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Signature** | **Trainer Initials** | **Date** |
| **Daniel Karp** | A necklace on a black background  Description automatically generated | **DK** | **5/15/20** |
| **Daniel Paredes** |  | **DP** | **5/22/20** |
| **Naresh Devarajan** |  | **ND** | **5/22/20** |
| Alison Ke | A picture containing drawing  Description automatically generated | **AK** | **5/22/20** |
| **Katherine Lauck** |  | **KL** | **5/23/20** |
| **Elissa Olimpi** | Macintosh HD:Users:wawa:Desktop:Screen Shot 2018-09-06 at 11.39.11 AM.png | **EO** | **5.24.20** |
| **Katia Goldberg** |  | **KRG** | **5/23/20** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |