La Selva Laboratories Management and

Safety Procedures

I. General information

La Selva offers 1000 m2 of laboratory infrastructure where station users can have personal working space with or without Air Conditioning (A/C). The reservation fees include office space or a laboratory bench (approximately 1.5 m desk or bench space) for every researcher who visits the station. Additional space may be rented upon request. The Laboratory Manager assigns office and lab space and must be notified ahead of time of special needs. La Selva currently has office and lab space as follows: 67 office spaces contained in 35 air-conditioned offices with locking door (two or three researchers per office), 16 lab bench spaces in the Analytical (New) Lab, 14 bench spaces in the Ambient Lab, 6 desk spaces in the Biodiversity building, 2 bench spaces in the Molecular Lab and 2 bench spaces and a desk in the Microbiology Lab.

II. Laboratory facilities

A. Working hours and personnel schedule

All lab facilities are available 24 hours a day, 7 days a week, and can be used by all resident students and researchers at the station, prior coordination with the Lab Manager. Lab personnel (manager and technician) work during office hours, Monday to Friday from 7:00 am to 5 pm. Occasionally, the lab personnel alternate schedules to extend lab assistance to the weekends, during high season visitation.

B. Electricity

The entire station has power supply all day and a backup electrical generator is automatically set if the external electricity supply fails. Specific projects that demands heavy consumption of electricity may be required to pay a corresponding fee. This applies to projects that require additional equipment installation besides the station instrumentation set up.

C. Research assistants

La Selva can help researchers to hire local assistants. This is coordinated by La Selva's accounting department. When a project or researcher hires an assistant to work in La Selva, OTS will represent the employer and manage all legal requirements including payrolls, social charges, insurances, etc.

Workers or Project Assistants whose responsibilities do not include the use of lab facilities are not allowed to use the laboratory.

D. Working spaces

The Lab Manager is responsible for assigning each researcher that arrives at La Selva to a working space in the laboratories. The space assigned can be a desk in an office, or a lab bench, depending on his/her needs and on the availability of lab space. The different laboratories include the Analytical, the Environmental Microbiology, Molecular, and Ambient Laboratories. The Ambient Lab is a screened area mainly designed to process gross samples and conduct experiments under ambient conditions. The old laboratory building comprises 26 offices and the library. All buildings have wireless internet access and 120 V power outlets; the Analytical Lab have also a few 220 V outlets.

When researchers leave the station for more than two weeks, the space must be vacated. When leaving La Selva, the researcher must leave the space empty and clean. Any remaining objects will be discarded. Researchers and assistants can keep a space reserved during their absence if they pay the corresponding fees. The use of a cabinet is considered part of the lab space but researchers have to bring a padlock for his/her cabinet.

Bench spaces with equipment, such as scales, water baths, fume hoods or sinks are for general use and will not be assigned to any particular person. Researchers have to inform the lab manager when leaving materials or samples in public areas. Any object left in these places should be clearly labeled. When the labs are cleaned, La Selva will not be responsible for expired reagents or abandoned objects that are not labeled.

E. Shadehouses

The station has eight 40 m2 shade houses with different grades of shade cloth and the capacity for six tables in each one. Shade houses are generally used for conducting plant growth experiments under light controlled conditions. One shade house has plastic roof and all of them have double doors. To reserve space in shade houses, arrangements must be made with the Lab Assistant. The fee for renting one table in a shade house is of $11 per month.

F. Stockrooms

Storage for researchers' belongings is limited and is only offered when the researcher is absent from the station. The service is free when storing packages for less than one month. Otherwise, researchers must pay a storage fee. A limited A/C storage area is available for sensitive equipment and materials that require low humidity storage conditions. Keep in mind that the available space under A/C is very limited!

There are specific areas for chemical storage, glass ware and batteries. A form must be filled out and the user must keep a copy of this form to confirm the storage of equipment or samples. The following information must be provided:

a) Name
b) Storage date
c) Return date
d) Owner's telephone and e-mail address
e) Indication whether or not the equipment needs to stay in air conditioning
f) Type of materials to be stored

If a researcher does not return to the station in one year and does not pay the storage fee, the station will either make use of or dispose of the stored material.

G. Laboratory instruments and equipment

The laboratory has basic and standard lab equipment such as scales, microscopes, magnetic stirrers, centrifuges, water baths, etc.

The user must know the equipment's function, operation and care. If not, the user must request help from the Lab Assistant or the Lab Manager, and will have access to standard operating procedures.

Balances, pH meters and the leaf area meter are regularly calibrated by a lab technician. If researchers need to calibrate these equipment, please consult the lab personnel.

Any equipment or instruments used should be returned in good and clean condition. Researchers cannot move any OTS equipment without the Lab Manager's authorization.

Some instruments such as the gas chromatographs, the liophylizer, and the spectrophfotometer, should be used only by researchers who have previous experience with them or has been trained on its operating procedures. Use of these instruments must be coordinated ahead of time, so the Lab Manager can help with the setup of the instrument.

A list with more details about the equipment available can be found at our web site: www.tropicalstudies.org.

H. Refrigerators and freezers

Refrigerator and freezer space is provided by OTS to store solutions or samples. They are NOT allowed for food storage. The user should ask the Lab Manger for assigning space in them. All solutions and samples must be properly labeled. Solutions must be stored in their own containers, not in lab glassware. Stored material that is not properly labeled can be discarded without warning.

The refrigerators and freezers are intended for use only during the researcher's stay at the station. If you need to keep things in refrigerators and freezers after leaving the station, the Lab Manager must be informed. Depending on the volume used, a fee of $10/month will be charged for this service.

Any stored material must be clearly labeled with the following information:

a) Researcher's name
b) Project name
c) Content (Name of the reagent, sample, etc.)
d) Preparation date
e) Expiration date (if applicable)
f) Date in which it will be taken out of the refrigerator or freezer

Regularly, the lab personnel will review the contents of refrigerators and freezers. If there are objects that do not contain the above information, if the owner is not at the station any more, or if the storing date has expired, they will be disposed.

I. Ovens and dryers

The lab has 8 ovens and one dryer, usually operated at ~70 °C. To reserve an oven or a space in it, arrangements must be made with the lab assistant and should include the type of samples to be dried and the temperature to be used. The data sheet posted on each unit should be filled out for the respective days. When using an oven, the temperature should be checked periodically as a safety measure for fire. Do not overload the ovens and please leave space between the samples. For leaf litter and other samples with high amount of water, a pre-dry process should be made to avoid corrosion of the units. After using it, the oven should be turned off and cleaned.

J. Supplies and glassware

The laboratory maintains glassware available for researcher use. After using glassware, they must be cleaned and dried. Any questions about the washing routine should be directed to the lab assistant. Any broken material must be reported to the Lab Assistant or the Lab Manager and disposed of in the appropriate container. The glassware broken will be replaced and charged to the researcher's or course's account. The laboratory has materials and supplies for public use, such as those located in the balance room and in the lateral drawers.

Herbarium and insect collection.

K. GIS laboratory.

L. Other facilities

A public laser printer is located on the first floor of the old laboratory. You can install and use this printer with your computer. Please, print only what is necessary, print on both sides of the paper, reused if possible and recycle.

There is a public phone next to the weighing room in the new lab and two more in common areas in the old laboratory. These phones can be used for internal calls and a list of telephone numbers of all departments and staff members are posted on the wall next to the phones. Any emergency should be reported to reception ext. 110 from 7:00 to 17:00 or the main guard ext. 119 during the night.

There is very good signal radio communication throughout the whole station. The Lab Manager can lend radios to researchers who do work deep in the forest, during the night, or in special places or conditions that require constant communication with staff for safety or technical reasons. Any other researcher who doesn’t have a radio should sign the entry-exit control whiteboard next to the ovens room on the lab's hall.

Fax: The Station has a fax machine at reception.

Bicycles: The Station offers bicycles for researchers. Ask the Reception Staff about this service.

M. Courses

The Academic Groups coordinator assigns students and faculty a classroom and lab space at the Academic Center building. If a student or a group of students need to use the lab facilities for their projects, a temporary lab space in the analytical lab can be assigned. However, they must be constantly supervised by the course staff. When a course is planning to use the laboratory facilities, this must be indicated in the reservation and coordinated with the Lab Manager.

III. Chemical management

N. Laboratory Chemical Supplies

The Laboratory provides some common-use chemical reagents. (e.g. ethanol, acetone, etc). If your study needs specialized chemical reagents or high amounts of general chemical reagents, the Lab manager can help with the purchase coordination with local providers and the reagents will be brought to La Selva for you. OTS charges a 25% fee for this service. The use of some hazardous chemicals may be banned, taking into account health risks and waste disposal.

O. Using chemicals in the lab

Researchers must give a list to the Lab Manager of all chemicals brought to the station and include the following information from each one of them:

a) Name and formula
b) Quantity
c) Toxicity
d) Wastes produced and benchtop neutralization protocols if applicable

For basic security, all bottles and containers must be clearly labeled with the following information:

a) Name of the substance or reagent.
b) Date of preparation (if applicable).
c) Project and owner's name.

The precautions specified on the Material Safety Data Sheets (MSDS) must be followed.

Lab users should use bottle compartment carriers to transport hazardous chemicals through the corridors of the laboratory. Polyethylene safety type bottle compartment carriers can be found next to the hoods or in the chemicals stockroom.

When storing chemicals, incompatible materials must be placed separately. Refer to MSDS and Apppendix A and B for specific incompatibilities. Heavy containers with hazardous chemicals must not

go on the shelves. There are special cabinets in the main laboratory to store strong acids, bases and organic solvents (these should be kept away from high temperatures, or equipment that can produce sparks). The Lab Manager or Lab Assistant should be consulted if there are questions about chemical storage.

If a researcher needs to keep compressed gas cylinders in the lab, they must be secured in a vertical position with chains or straps. To transport tanks, the lab has is a special cart with a chain to secure the tank. If the cylinders are not in use, the exit valve should be protected with a safety lid.

When working with hazardous chemicals, goggles, gloves, mask (of the appropriate type) and lab coat must be used. The gloves have to be resistant to the chemicals being used. There are asbestos gloves suitable to manipulate hot objects or equipment. Vapor hoods are to be used when working with hazardous volatile materials. The fume hood door should be partially closed to protect against splashes, and safety goggles must always be used. To use the hood, the air extractor must be on. The hoods must be left clean and dried after being used.

Safety gear such as goggles, masks and gloves are available in the lab. Researchers must bring their own lab coats.

P. Chemical waste management

OTS encourages researchers to incorporate waste minimization practices when starting a project where hazardous materials will be used. Chemical treatments and preparations should be done at a micro-scale whenever possible as well as the substitution of hazardous materials for safer alternatives.

Every lab user will be responsible for all chemical wastes produced during his work. The responsibilities include the appropriate collection, labeling and managing of all chemical wastes in coordination with the Lab manager and according to the national standard guidelines in “Reglamento General para la Clasificación y Manejo de Residuos Peligrosos N° 37788-S-MINAE”.

The first step is to choose the right containers according to the chemical waste compatibility. Each container should be filled up to 90% of its maximum capacity. Liquid substances should be stored in a second container to avoid spillage.

Containers with hazardous materials are inspected for closure, compatibility, condition and correct labeling. When all requirements are accomplished chemical wastes are stored in a specific area, away from the main laboratories buildings and segregated according to chemical compatibles (refer to MSDs and Appendices A and B for information about incompatibilities). The storage space must be clean, dry and well ventilated.

A certified company (*https://www.ministeriodesalud.go.cr/index.php/informacion/gestores-de-residuos-ms*) is hired for the pick-up and correct chemical waste disposal according to the Ministerio de Salud de Costa Rica, and researchers are charged a fee for the service (calculated based on the amount of waste, type of treatment, and logistics).

Benchtop neutralization protocols are allowed if following standard methods, as in Hazardous Laboratory Chemicals Disposal Guide. 3rd Edition (Margaret-Ann Armour 2003). Anyone who applies chemical deactivation protocols will have to provide all the necessary materials or reagents and conduct the deactivation themselves. Any questions or issues related to the chemical waste management should be addressed to the lab manager.

IV. Safety and general precautions

Blocking the access to fire-extinguishers, showers, sinks or exits of the Laboratory must be strictly avoided.
Smoking or eating is not permitted in the Labs.

The electrical circuits in the Laboratory are 115 V AC, 60 Hz, 15 Amp. They must not be overloaded. Do not use multiple exit connectors unless they have their own individual fuse. Before using any electronic equipment, the researcher should carefully read the corresponding manual and/or ask the Lab Manager. Electrical extension cords can be used only temporarily. These should not go under doors, across corridors or hang from the ceiling. If a researcher needs to use additional electrical connections for a long period of

time, the Lab Manager should be informed. Working areas must be kept dry when working with electrical devices.

We request that all users cooperate with efforts to save energy. Turn off the lights and equipment when they are not in use including the extractor hoods and bathroom fans. Also, close all outside doors to avoid A/C leaks.

For protection and the safety of children (some researchers bring their children to the station), no one under the age of 12 is permitted in the analytical laboratories. La Selva accounting department can help in hiring child-care worker services on site. Visitors of ages between 12 to 18 who are passing through or touring a laboratory must be under the direct supervision of an OTS employee who is trained and knowledgeable of the area's hazards. Persons between the ages of 12 and 18 may be present in laboratories solely as observers (unless the person is a student who has received the necessary training).

Classify your garbage (glass, paper, plastic bottles, aluminum cans and alkaline batteries) and put them in the proper containers located outside the lab.

References

1. International Labor Organization. http://www.ilo.org/public/english/protection/safework/cis/
2. The U.S. Environmental Protection Agency. http://www.epa.gov
3. The National Institute for Occupational Safety and Health. http://www.cdc.gob/niosh/homepage.html
4. The National Library of Medicine. http://www.nlm.nih.gov
5. Sociedad Americana de Química. http://www.chemistry.org
6. Universidad de Burgos, España. http://www.ubu.es/servicios/seguridad/recomendar/lab_qui.htm
7. Margaret-Ann Armour (2003) *Hazardous Laboratory Chemicals Disposal Guide*. 3rd Edition.
8. Goel, S. ed. (2017). *Advances in Solid and Hazardous Waste Management*. Cham: Springer International Publishing doi:10.1007/978-3-319-57076-1.

Related Legislations and regulations (Costa Rica)

- Ley Orgánica del Ambiente. No. 7554. (1996).
- Ley General de Salud No. 5395. (1973).
- Ley para la gestión integral de residuos (2010).
- Reglamento General para la Clasificación y Manejo de Residuos Peligrosos (2013).
- Reglamento General de Seguridad e Higiene del Trabajo. (1982).
- Reglamento General para el otorgamiento de permisos sanitarios de funcionamiento (2008).
- Reglamento sobre las características y el listado de los desechos peligrosos industriales (1998).
- Reglamento para el manejo de desechos peligrosos industriales (1998).
- Reglamento sobre la gestión de los desechos infectocontagiosos que se generan en establecimientos que presten atención a la salud y afines (2003).
- Reglamento de vertido y reuso de aguas residuales (2007).

Appendix A

RCRA's (Resource Conservation and Recovery Act, EPA) Chemical Waste Compatibility List

The mixing of Group A materials with Group B materials may have the potential consequences noted.

Group 1-A	**Group 1-B**
Acetylene sludge	Acid sludge
Alkaline caustic liquids	Acid and water
Alkaline cleaner	Battery acid
Alkaline corrosive liquids	Chemical cleaners
Alkaline corrosive battery fluid	Electrolyte, acid
Caustic wastewater	Etching acid liquid or solvent
Lime sludge and other corrosive alkalies	Pickling liquor & other corrosive acids
Lime wastewater	Spent acid
Lime and water	Spent mixed acid
Spent caustic	Spent sulfuric acid
Potential consequences: Heat generation; violent reaction	

Group 2-A	**Group 2-B**
Aluminum	Any waste in Group 1-A or 1-B
Beryllium	
Calcium	
Lithium	
Magnesium	
Potassium	
Sodium	
Zinc powder	
Other reactive metals and metal hydroxides	
Potential consequences: Fire or explosion; generation of flammable hydrogen gas	

Group 3-A	**Group 3-B**
Alcohols	Any concentrated waste in Groups1A or 1B
Water	Calcium Lithium
	Metal hydrides
	Potassium
	SO2Cl2, SOCl2, PCl3, CH3SiCl3
	Other water-reactive waste
Potential consequences: Fire, explosion, or heat generation; generation of flammable or toxic gases	

Group 4-A	**Group 4-B**

Alcohols	Concentrated Group 1-A or 1-B wastes
Aldehydes	Group 2-A wastes
Halogenated hydrocarbons	Nitrated hydrocarbons
Unsaturated hydrocarbons	Other reactive organic compounds & solvents
Potential consequences: Fire, explosion, or violent reaction	

Group 5-A	**Group 5-B**
Spent cyanide and sulfide solutions	Group 1-B wastes
Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulfide gas	

Group 6-A	**Group 6-B**
Chlorates	Acetic acid and other organic acids
Chlorine	Concentrated mineral acids
Chlorites	Group 2-A wastes
Chromic acid Group 5-A wastes	
Hypochlorites Other flammable and combustible wastes	
Nitrates	
Nitric acid	
Perchlorates	
Permanganates	
Peroxides	
Other strong oxidizers	
Potential consequences: Fire, explosion, or violent reaction	

Appendix B Chemical Mixing Compatibility Chart

Chemical Mixing Compatibility Chart

[to assist with safe chemical segregation]

Modified From:

Source: EPA-600/2-80-076 / April 1980

A Method for Determining the Compatibility of Chemical Mixtures

and from University of Arizona

Reactivity Code	Consequence
H	Heat Generation
F	Fire
G	Innocuous and Non-Flammable Gas Generation
GT	Toxic Gas Generation
GF	Flammable Gas Generation
E	Explosion
P	Violent Polymerization
S	Solubilization of Toxic Substance
U	May be Hazardous But Unknown

Example

H,F, GT	Heat Generation, Fire, and Toxic Gas Generation

Reactivity Group No.	Reactivity Group Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1	Acids, Mineral, Non-Oxidizing	1																																								
2	Acids, Mineral, Oxidizing		2																																							
3	Acids, Organic		G, H	3																																						
4	Alcohols and Glycols	H	H, F	H, P	4																																					
5	Aldehydes	H, P	H, F	H, P		5																																			
6	Amides	H	H, GT				6																																		
7	Amines, Aliphatic and Aromatic	H	H, GT	H		H		7																																	
8	Azo Compounds, Diazo Compounds and Hydrazines	H, G	H, GT	H, G	H, G	H			8																																
9	Carbamates	H, G	H, GT						G, H	9																															
10	Caustics	H	H	H		H				H, G	10																														
11	Cyanides	GT, GF	GT, GF	GT, GF					G			11																													
12	Dithiocarbamates	H, GF, F	H, GF, F	H, GF,		GF, GT		U	H, G				12																											
13	Esters	H	H, F						H, G		H			13																											
14	Ethers	H	H, F												14																										
15	Fluorides, Inorganic	GT	GT	GT												15																									
16	Hydrocarbons, Aromatic		H, F														16																								
17	Halogenated Organics	H, GT	H, GT, P					H, GT	H, G		H, GF	H						17																							
18	Isocyanates	H,G	H, GT, P	H, G	H, P			H, P	H, G		H, P, G	H, G	U						18																						
19	Ketones	H	H, F						H, G		H	H								19																					
20	Mercaptans and Other Organic Sulfides	GF, GT	H, GT, F						H, G									H	H	H	20																			
21	Metals, Alkali and Alkaline Earth, Elemental	GF, H, F	GF, H, F	GF, H, F	GF, H, F	GF, H, F	GF, H	GF, H	GF, H	GF, H	GF, H	GF, H	GF, GT, H	GF, H								21																	
22	Metals, Other Elemental Alloys as Powders, Vapors, or Sponges	GF, H, F	GF, H, F	GF					GT, H, F	U	GF, H							H, E	GF, H		GF, H, F		22																	
23	Metals, Other Elemental Alloys as Sheets, Rods, Moldings, Etc.	GF, H, F	GF, H, F						H, F, G									H, F						23															
24	Metals and Metal Compounds, Toxic	S	S	S			S	S			S														24															
25	Nitrides	GF, H, F	H, F, E	GF, H	GF, H, E	GF, H			U	H, G	U	GF, H	GF, H	GF, H				GF, H	U	GF, H	GF, H	E			S	25														
26	Nitriles	H, GT,	GT, H, F	H							U											H, P			S	GF, H	26													
27	Nitro Compounds, Organic		GT, H, F			H					H, E											GF, H, F				GF, H, F		27												
28	Hydrocarbons, Aliphatic, Unsaturated	H	H, F			H																	H, E						28										
29	Hydrocarbons, Aliphatic, Saturated		H, F																					29						29										
30	Peroxides and Hydroperoxides, Organic	H, G	H, E		H, F	H, G		GT, H	H, F, E	GT, H, F		GT, H, E	GT, H, F					H, E	H	GT, H, F	H, E	H, G	H, G		H, G	GF, H, E	GT, H, P		H, P		30										
31	Phenols and Cresols	H	H, F						H, G										H, P			GF, H				GH, H					H	31								
32	Organophosphates,Phosphothioates, Phosphodithioates	GT, H	GT, H						U		H, E											H				U							32							
33	Sulfides, Inorganic	GT, GF	GT, H, F	GT		H			E										H							GT, H								33						
34	Epoxides	H, P	H, P	H, P	H, P	U		H, P	H, P		H, P	H, P	U								H, P	H, P	H, P		H, P	H, P					H, P	H, P	U	H, P	34					
35	Combustible and Flammable Materials, Miscellaneous	H, G	GT, H, F																			H, G, F				GF, H, F					GT, H, F				35					
36	Explosives	H, E	H, E	H, E					H, E		H, E			H, E								H, E	H, E	H, E	E	E					H, E	H, E		H, E	H, E	H, E	36				
37	Polymerizable Compounds	P, H	P, H	P, H					P, H		P, H	P, H	U									P, H	P, H	P, H	P, H	P, H					P, H	P, H		P, H		H, E	37			
38	Oxidizing Agents, Strong	GT, H		GT, H	H, F	H, F	GT, H, F	GT, H, F	H, E	GT, H, F		GT, H, F	GT, H, F	H, F	H, F		H, F	GT, H	GT, H, F	H, F	GT, H, F	H, F, E	H, F, E	H, F		H, F, E	GT, H, F	H, E	H, F	H, F	H, G	H, F	GT, H, F	GT, H, F	H, G, F	H, G, F	H, E	GT, H, F	38		
39	Reducing Agents, Strong	GF, H	GT, H, F	GF, H	GF, H, F	GF, H, F	GF, H	GF, H	G, H				GT, H	H, F				H, E	GF, H	GF, H	GF, H						GF, H	H, E			H, E	Gf, H	GF, GT		H	GF, H	H, E	GF, H, P	H, F, E	39		
40	Water and Mixtures Containing Water	H	H						G										H, G			GF, H	GF, H		S	GF, H							GF, GT						GF, GT	40	
41	Water Reactive Substances	<---<---<---<---Extremely Reactive! --- Do Not Mix With Any Chemical! --- Extremely Reactive--->--->--->--->																																							41
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41