Master Plan 2017-2027

Cayo Santiago Field Station

Caribbean Primate Research Center
University of Puerto Rico

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This material is based upon work supported by the National Science Foundation under Grant No 1624434. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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I. Introduction

Cayo Santiago Field Station (CSFS) is the oldest, continuously operating, free-ranging rhesus macaque (*Macaca mulatta)* colony in the world, serving for over 75 years as an international research, educational, and training resource. The station is an off-campus facility administered by the Caribbean Primate Research Center (CPRC) of the University of Puerto Rico-Medical Sciences Campus (UPR-MSC) (Appendix 1). Its long-term research tradition extends back to the 1930's, providing a scenario for studies in the fields of sociality, cognition, genetics, sexual behavior, functional morphology, parasites, demography, and ecology. Such a broad multidisciplinary approach offers a unique resource for cooperative studies including collaborations between local and international researchers, a significant attribute as the UPR-MSC is the only minority institution of higher education in the USA with a primate center. Today, CSFS is composed of two main facilities, both located in Punta Santiago, Humacao: the island of Cayo Santiago (CS from now on) and the Punta Santiago facilities (PS from now on) (recently acquired building). The acquired building offers the ideal space to develop adequate biological field station facilities (e.g., administrative offices, housing unit, and storage rooms). More, importantly, for the first time in CSFS's history, there is a possibility of acquiring equipment to support the laboratory work that usually is done abroad, which will reduce the hassle of exporting biological samples to laboratories outside of Puerto Rico. The current master plan addresses communication system development, infrastructure and space limitations, but also includes a projected development of research and education activities for the next ten years.

The 2017-2027 Master Plan was developed based on the results of a National Science Foundation (NSF) funded workshop conducted in San Juan, September 27th-29th, 2016 (Award # 1624434). The workshop was composed of 25 national and international researchers and professionals from different backgrounds; researchers, field site directors, scientists working on K-12 Education, UPR-MSC administrators, and academic infrastructure developers (Appendix 2). The master plan revised the mission and goals of the CSFS and defined the direction the station should take to achieve its full potential as an international research and education facility.

Priorities, proposed improvements, and additions described on this plan are divided into four main sections. Each section presents short-term (1-5 years) and long-term goals (6-10 years) within the 10-year period. The first three sections correspond to each of the planning effort specific aims:

(i) to discuss the potential for growth of research at CSFS and determine the necessary technological renovations that should take place to accomplish such a goal (1. Facilities Needs section)

(ii) to discuss a plan for developing an academic program that can offer summer or academic year research activities for undergraduate students interested in the fields of primate behavior, biodemography, cognition, and/or genetics (2. Academic Development section)

(iii) to discuss the development of an outreach program for school students and the general public with regular visits to the facility (3. Outreach section)

The fourth section (4. Administrative Needs) focuses on the intellectual, technical and economical aspects that the station should consider in order to accomplish all goals in sections 1-3.

The 2017-2027 Master Plan organizing committee was formed by Angelina Ruiz-Lambides (CSFS Scientific Director), and Raisa Hernández-Pacheco (CPRC Scientific Staff). As a result of the workshop, a Field Station Advisory Committee (FSAC-CS) was established to advise the CPRC Director on current activities and future projects and goals, including risk management, related to this master plan. The FSAC-CS members is composed of the CPRC's Director, the Associate Director Cayo Santiago Field Station, one CPRC Scientific Staff, two active CSFS Principal Investigators, one Outreach Program Director, two external Biological Station Directors.

Vision

To advance biological sciences through the integrated study of nonhuman primates' behavior, genetics, morphology, and ecology.

Mission

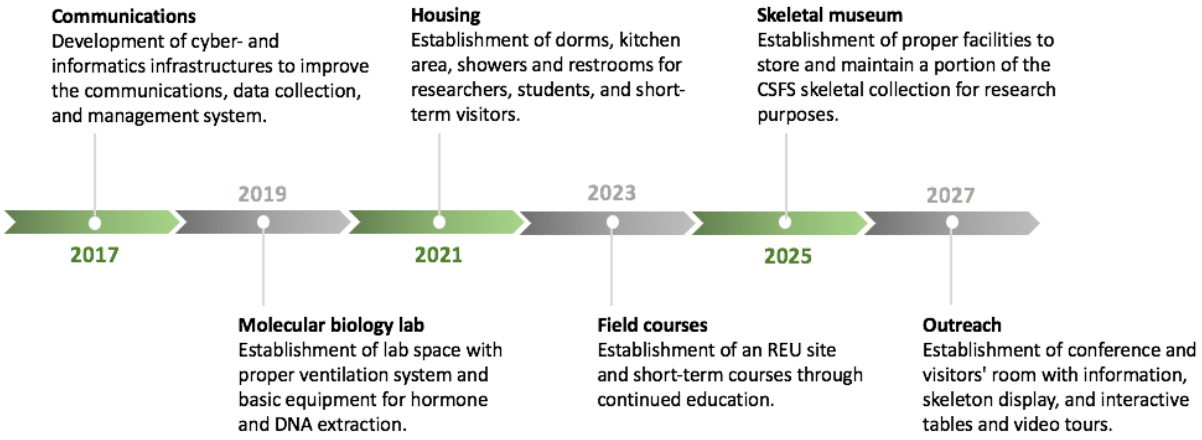
The Cayo Santiago Field Station supports the advancement of interdisciplinary studies on nonhuman primates by providing the infrastructure to combine field observations with demographic, genetic, and skeletal information.

Value and legacy of the station

Cayo Santiago is one of the world's most renowned field sites for both short-term and longitudinal nonhuman primate studies. Its unique research value consists of a minimally disrupted long-term population management policy which allows researchers to plan and conduct studies in multiple disciplines. CSFS possesses the most extensive, computerized, inter-generational demographic database for a nonhuman primate population available to researchers in the world. Such a demographic database, together with the most comprehensive genetic database on short tandem repeats and skeletal collection, offers unique information for setting up the framework for interdisciplinary studies on the relationships between social behavior, morphology, physiology, genetics, spontaneous occurrence of disease, life-history, and evolution.

II. Cayo Santiago Field Station

The general goals of the 10-year master plan are summarized in the following 10-stage calendar (dates are provided as proposed deadlines for the goal, rather than a starting date):



The 10-stage linear plan is organized into four planning divisions (Facilities needs, Academic Development, Outreach, and Administrative needs), each with the following short- and long-term goals:

1. Facilities Needs

Short-term

A. Digitalization of historic visual census data. Currently, the historic archives that build the long-term demographic data base of Cayo Santiago macaques (daily data since 1950's to present) are stored in metal cabinets at PS under risk of destruction (e.g., humidity, fire, robbery, loss). These paper files contain not only demographic data, but also visual data on mating, fighting, migrations, and location-related activities of individuals that have never been digitized. Each file needs to be scanned, digitalized, and stored. The data in each scan needs to be entered into the database.

B. Improve current power system. Power at PS needs to be consistent to avoid power surges that could jeopardize administrative activities, ongoing research, and sample storage. Further, there is a major need to establish an efficient source of electricity in CS as the current generator does not cover the entire island and represents only an emergency back up with noise contamination. Noise contamination affects audio-video behavioral data recording.

a. At PS, there is a need to establish regular maintenance of current back-up power generator.
b. At CS, there is a major need to provide a wind generated power system to support the laboratory located on the island, as well as provide cyberinfrastructure (i.e., WiFi) which would allow real-time upload of daily data collection by the staff, as well as by the station's users.

C. Update how population data are collected and stored. The collection of daily visual census data is a time-consuming task. The current system has four census takers collecting notes on the entire population in the field using pencil and paper, which are then transcribed into a computer. This system is time intensive, can introduce errors into the data, and poses a risk of data loss and damage. This system needs to be modernized to improve data quality and to increase the amount of time (already over-extended) the staff can dedicate to other duties. This long-standing situation should be avoided in the future by providing:
    a. WiFi at CS, and improvement of WiFi at PS
    b. Hand-held devices (e.g., tablets) for field data collection and storage in real-time
    c. Server or cloud
    d. Software for data collection and management that consolidates all information available for each individual (e.g., life history, genetic data, skeletal data, health data) allowing CSFS Director and colony managers to manage the data from CSFS in real-time communication with Sabana Seca Field Station

D. Establish bench space and lab equipment. A substantial number of active researchers collect fecal, urine, blood, and tissue samples in the field for hormone and DNA extraction; two processes with overlapping equipment. The station should provide bench space for sample processing and shipment of hormones and DNA already extracted. This will optimize the time researchers spend in the station and the use of the facility, potentially expanding research, attracting more researchers, and generating income. There is major need to provide:
    a. Bench space with a biological safety cabinet and proper ventilation system with temperature and humidity control
    b. Freezer space for tissue sample storage
    c. Laboratory equipment for hormone and DNA extraction (Appendix 3)
    d. Adequate Biosafety Levels

E. Improve housing facilities. Currently, PS has a trailer-housing unit with two bedrooms being used primarily for interns during the annual trapping season or by those that volunteer in behavioral data collection. The trailer should be

removed from PS to SSFS and dormitory space should be established instead with beds, kitchen area, and showers for the station's users. This will supply SSFS a housing unit for researchers, which is not currently available, and provide open space for public activities and gatherings at PS. These areas should be separated from the corresponding staff areas. Housing is necessary to develop academic programs.

Long-term

A. Establish a skeletal research museum. Currently, carcasses collected in the field are macerated at Sabana Seca, identified, and stored in the Laboratory of Primate Morphology on the Medical Sciences main campus. In order to expand interdisciplinary research opportunities, the station should be able to store its own skeletal collection for research purposes, or at least it should be able to store a portion of the skeletal collection on site so that the station's users have all resources in one space. Currently, students struggle for obtaining funding for travel, housing, and bench fees. Having a portion of the skeletal collection at the station, rather than on campus which is 1-hour one-way drive, would open up new research possibilities. More importantly, this will promote the use of the collection on campus, as it is significantly underused. The major needs to establish the skeletal museum are:
    a. Establishment of a proper ventilation system for the maintenance of skeletons.
    b. Equip the room with proper cabinets for each specimen.

B. Establish control of user access. A security system with individual access cards for active station's users should be considered to improve security and also to adequately register the use of the facilities and user fees invoicing to Principal Investigators (PIs).

2. Academic Development

Short-term

A. Develop an annual CSFS scientific web-conference where ideally all active PIs, students, and other researchers present their work and latest findings. The web-conference should take place at the facilities and be open to the UPR and local Punta Santiago community.

B. Develop short-term summer courses through continued education that offer lab and/or field methods experience to the public (e.g., undergraduate students, schoolteachers, and lab and field technicians). The station could consider PIs to teach the course in exchange of bench fee discount.

C. Establish remote access to UPR-MSC library and electronic journals. This should be done with the UPR-MSC, as the station users should have the same access that students and faculty have on campus.

Long-term

A. Apply for a Research Experience for Undergraduates Site (REU Site). For this, active PIs could participate in the proposal as non-senior members and should take the role of undergraduate students' mentors, offering a research experience in their research area. Their graduate students can also be considered as mentors.

B. Develop a formal UPR inter-campus course for both undergraduate and graduate students (course code over 5000), preferably during summer time. The course can be focused on Primatology or Behavioral Ecology, which are currently absent within the academic offering of the UPR system.

C. Create collaborations with the School of Public Health on campus to develop a course on non-human primate demography or incorporate the use of the Cayo Santiago rhesus macaque demographic data in their formal courses.

3. Outreach

Short-term

A. Improve current outreach activities at schools. Staff visits to schools should not only include talks on rhesus macaques, but also include talks on current research at CSFS in order to increase interest from school teachers and students. The outreach program should initially target school teachers so that a long-term teacher-station partnership is created, resulting in continuing school visits to the station.

B. Establish an alliance with the Department of Education of Puerto Rico to develop activities that allow public school students to participate in workshops and visits to the station. This can be done under the newly proposed Programa Contacto Verde ("green contact") by the Department (Carta circular 19-2015-2016)

C. Establish a schedule for weekly general visitors. The visits would be guided and the schedule would not overlap with research hours. Thus, the station should consider providing guided visits from 2:30pm-5:00pm. Visitors need to be in compliance with the Medical Clearance and Access to Cayo Santiago for general visitors (http://cprc.rcm.upr.edu/?q=cayosan).

D. Create a room for open houses activities so that the community can be integrated into the new facilities at Punta Santiago.

Long-term

A. Establishment of a conference room. A conference room could serve as space for scientific gathering, but also as a space for outreach activities such as live-streaming from the field, movies, videoconferences with scientists and open houses activities for the local community of school students and general public.

B. Establishment of a visitor's room. The station should provide a visitor's room with visual information of the history, vision and mission of the station, past and ongoing research. A Cayo Santiago mockup, skeletal displays, TVs with video tours of Cayo Santiago and pictures would allow a rich experience for school students and local community that cannot visit Cayo Santiago.

C. Live video tours of Cayo Santiago. Given the limitations in terms of assumptions of risk for minors visiting Cayo Santiago, the outreach program can be further improved with cyber-infrastructure. PIs and graduate students should be encouraged to participate of this live video-tours that will be played at the visitor's room. For this, PI's can make use of technology provided by the station (i.e., tablets, Wifi) and live stream from the field describing their observations and methods used in the island.

4. Administrative Needs

Short-term

A. Users and fees:
   a. The current plan for users' access and fees should be revised to include a fee on field station maintenance. Starting in 2017, new submitted proposals should include a section in the budget for field station operations.
   b. The station has to expand its current plan for users' access and fees to a plan for WiFi, digitized data, lab users' access.
   c. Fees must also be established for media companies interested in visiting and recording at the station.

B. Research:
   a. Enforce a system of data management and data sharing for all research projects at Cayo Santiago. This includes the submission and archiving of data; as well as, data sharing terms, which state that after a certain period of exclusivity each researcher must make data available to the public in coordination with the CSFS data manager.
   b. Maintain and update the bibliography of scientific publications posted on the webpage.
   c. Identify a data manager that maintains the collections properly, inventoried and digitalized.

C. Education and training:
    a. Include the Unit of Comparative Medicine under the Dean of Academic Affairs or under other academic program on campus given the fact that Comparative Medicine is an administrative unit.
    b. Engage classes from the UPR-MSC, as well as from other campuses; especially from the the School of Public Health at UPR-MSC and Department of Anthropology at UPR Rio Piedras.
    c. Promote the study of other ecosystems (e.g., coral reefs, mangrove), organisms (e.g., sea birds), and/or their interactions with rhesus macaques at the station.

D. Outreach:
    a. Establish a Community Advisory Committee. Such a committee should be in direct communication with the station's director and provide the local community perspective on the station's activities, while enhancing and maintaining public trust and confidence between CSFS and the community.

Long-term

A. Research:
    a. Promote more independent research. The research community and the station will benefit of having a diversity of new research projects.

B. Education and training:
    a. Create a scholarship program in which local students are the main beneficiaries. Financial donations could be used to fund these scholarships. The station should consider the creation of a non-profit account ("Friends of Cayo") to receive monetary donations.

C. Outreach:
    b. The station should establish and maintained an up-to-date monthly schedule for outreach activities so that schools can reserve space to visit.
    c. Explore the integration to the field station of programs such as EARTHWATCH.
    d. Develop 1-day training workshop for schoolteachers. Interested PIs can be lecturers. Workshops can be focused on hands-on activities for science students (e.g., laboratory activities).

III. Appendices

Appendix 1. Cayo Santiago Field Station General Information

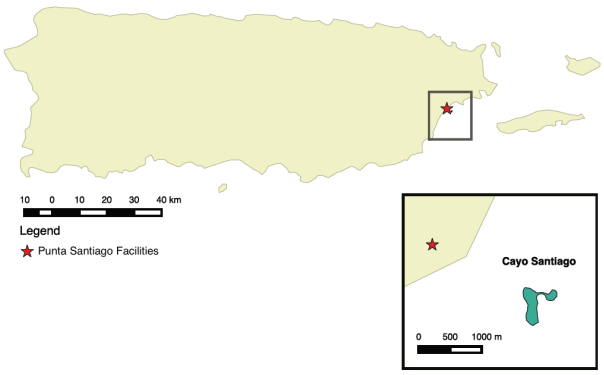


Figure 1. The Cayo Santiago island (green) and Punta Santiago facilities (red star), Humacao, PR.

Description. Cayo Santiago is a 15.2 ha subtropical island located in southeast Puerto Rico (18°09'N, 65°44'W) (Figure 1). It is made up of igneous, calcareous sedimentary and eolionite rock that arises out of the water up to 35m. This is covered by a diverse understory of vegetation including native species of the region such as Bay Rum trees (*Pimenta recemosa*), Mahogany trees (*Swietenia mahagoni*), Manchioneel (*Hippomane mancinella*), and red mangrove (*Rhizophora mangle*). Residing on this landscape several birds are found, including the Ruddy Turnstone (*Aranaria interpres*), Brown Pelicans (*Pelicanis occidentalis*), Frigate birds (*Frigata magnificens*), Great Blue herons (*Ardea herodias*), Great White herons (*Ardea occidentalis*), as well as lizards such as *Ameiva exsul* and *Anolis* spp. In such environment coexist the Cayo Santiago rhesus macaques. These macaques are all descendants of the original 409 Indian-origin founders of 1938 as no new additions to the population have been made apart from births. Monkeys live in multi-male, multi-female groups, organized in seven naturally-formed social groups.

In June 2016, CSFS acquired a building located at Punta Santiago to move offices and storage rooms which have been previously located at the Fishermen's Village (Figure 2). This building is comprised of 12 rooms to be converted into offices, storage, lab space, housing for visiting scientists and volunteers, one conference room, four bathrooms, and a computer room for the community. Office space, storage, and computer cubicles for station staff and users are already established.

Figure 2. Cayo Santiago Field Station facilities at Punta Santiago, Humacao. A) building entrance showing administrative offices, B) current computer lab for station's users, C) proposed housing area (left), D) designated lab space (See Supplementary Documentation).

Historical perspective. As modern primate studies began to emerge, increasing interest in the establishment of an old-world monkey colony in the Western Hemisphere started to arise among primatologists. One of the main objectives of such a facility was to establish a station that allowed the study of social behavior and population-level processes of primates in the field. In

1938, the Markle Foundation funded the School of Tropical Medicine of the University of Puerto Rico for the establishment of the Cayo Santiago free-ranging rhesus macaque colony, which consisted of releasing 409 rhesus monkeys shipped from India onto Cayo Santiago. Research began in 1940 with a landmark paper on sexual behavior of rhesus monkeys, as well as studies on physiology. Most significantly, the Cayo Santiago colony contributed in generating the concept of a National Primate Center, which consequently resulted in congressional support for the seven Regional Primate Centers, which still exist today in the mainland United States.

Under the administration of the UPR, CSFS was funded by the National Institute of Neurological Diseases and Blindness in the 1950's, which allowed the resumption of the visual population census, created the foundation for significant contributions to the fields of primatology and biology, to set the stage for an extensive longitudinal demographic database. In the 1970's the UPR-School of Medicine founded the CPRC at Sabana Seca, PR, which currently administers CSFS. Under the CPRC and with support of the National Science Foundation (NSF), as well as the NIH, Cayo Santiago emerged as a unique site for the study of not only primates but also for the study of fundamental biological hypotheses (Historical information taken from Rawlins RG, Kessler MJ. 1986. The Cayo Santiago Macaques: history, behavior and biology. Albany, NY: State University of New York Press).

Station use and funding. The station is currently visited and used by numerous faculty, technical staff, and students from the UPR, other academic institutions in Puerto Rico, mainland United States, and other countries. Every year the station receives over 30 students and researchers from around the world. During the past five years CSFS has supported several postdoctoral research projects, doctoral dissertations, master theses, and research assistantships with local and international investigators as mentors.

Currently CSFS is partially supported by the Office of Research Infrastructure Programs (ORIP) of the National Institute of Health (NIH), and the UPR. CSFS animal care, research, and training programs are monitored by the Institutional Animal Care and Use Committee of the UPR (IACUC) in accordance with United States Department of Agriculture (USDA) regulations and NIH guidelines, the United States Department of Agriculture (APHIS), and the NIH Office of Laboratory Animal Welfare (OLAW). The CPRC is an AAALAC International approved facility since 1992 (accreditation #000783).

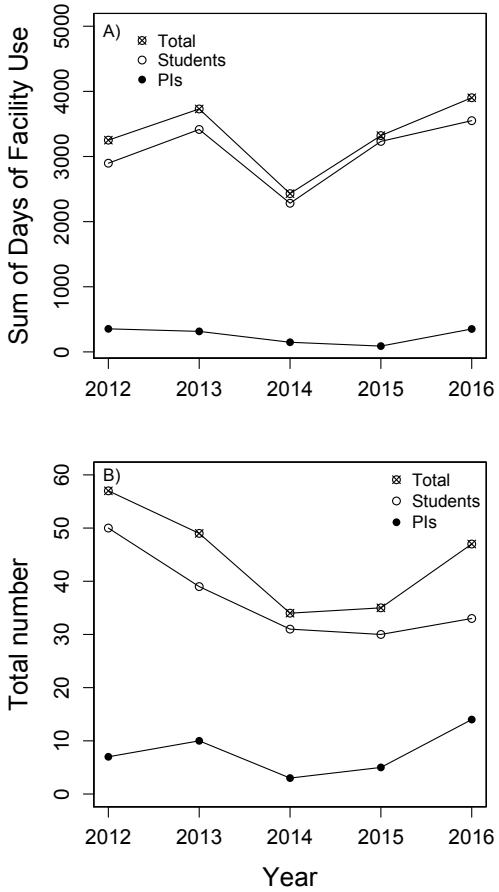


Figure 3. Annual facility use by students and principal investigators (PIs); A) total days of use, B) total number of visitors.

Appendix 2. Master Plan Workshop Participants

Participants	Affiliation	Expertise/Role
Lauren Brent	University of Exeter	Behavioral Ecology
Liz Díaz Vazquez	University of Puerto Rico-Río Piedras	K-12 Education
Anthony Di Fiore	University of Austin	Genetics/Primatology
James Higham	New York University	Behavioral Endocrinologist
Elizabeth Losos	Organization for Tropical Studies	Field Station
Amanda Melin	University of Calgary	Genetics/Primatology
Deus Mjungu	Jane Goodall Institute	Anthropology/outreach
Renee L Molina	Maderas Rainforest Conservancy	Field Station
Michael J. Montague	University of Pennsylvania	Neuroscience
Sarah Oktay	Rocky Mountain Bio Lab	Field Station
Michael Platt	University of Pennsylvania	Neuroethology
Laurie Santos	Yale University	Cognition
Anja Widdig	University of Leipzig	Primatology
Patricia Paladines	Centre ValBio	Field Station
Jess Zimmerman	University of Puerto Rico-Río Piedras	Field Station
University of Puerto Rico Medical Sciences Campus		
Angelina V Ruiz Lambides	Caribbean Primate Research Center	PI, Behavior/Colony Management
Raisa Hernández Pacheco	Caribbean Primate Research Center	Co-PI, Population Ecology
Gisselle Caraballo	Caribbean Primate Research Center	Colony Manager
Melween I Martínez	Caribbean Primate Research Center	Faculty/Administrator
Carlos A Sariol	Caribbean Primate Research Center	Faculty/Administrator
Yilda Rivera	University of Puerto Rico	Faculty/Administrator
Christopher Galan	University of Puerto Rico	Architect
Jennifer Lugo Cardona	University of Puerto Rico	Architect
Fernando E. Pla Gómez	University of Puerto Rico	Architect
Jorge Cedeño Raspaldo	University of Puerto Rico	Planning, Design, Construction

Appendix 3. Laboratory Equipment

Laboratory Equipment

Priority level 1:

Analytical balance
Biological safety cabinet
Budget for extended warrenties on equipment
Centrifuge (2ml - 50ml)
Centrifuge- mini
Freeze-drier and pump
Glassware set (flasks, test tubes, beakers, graduated cylinders)
Microcentrifuge
Mortar and pestle, spatulas, glass rods, tweezers (various small tools)
Pipette sets (0.1 through 5ml)
Purelab Flex 3 Tap to Type 1
Thermomixer
Vortex Multi-tube
Vortex- tabletop

Priority level 2:

Autoclave
Bead bath/water bath
Bead beater, beads, gel tubes etc
Freezer (-20° C)
Freezer (-80° C)
Fridge (-4° C)
Fume hood with storage for flammable reagents
Gel electrophoresis systems (gel molds, tanks, combs)
Gel visualization and imaging system
Ice machine
pH meter
Qubit
Thermocycler (standard)
Thermocycler for quantitative PCR

Additional needs:

Biohazardous waste disposal system
Power and backup
Positive air pressure
Ventilation for fume hood and BSC