



NIH funding for constructing a bat vivarium

Project Summary

This proposal outlines a request to establish the Bat Resource Center for the Study of Zoonotic Diseases at Colorado State University. **The Bat Resource Center** is a \$7.99M facility located adjacent to the Center for Vector-borne Infectious Disease and the Rocky Mountain Regional Biocontainment Laboratory. **It is uniquely designed to be a vivarium with the necessary environmental and biosafety controls to successfully breed and maintain bats for use as animal models.** This important animal model is critical to our understanding of viral pathogenesis and disease transmission as bats have been shown to be a reservoir for a number of human pathogens including the recent COVID-19 pandemic. The Bat Resource Center will greatly enhance our abilities to study these agents and will serve as a national resource for others using bat models.

Project narrative:

Pathogens transmitted by bat vectors continue to burden the health of humans around the world as evident by a number of emerging **zoonotic viruses** that cause high mortality in humans that originate in bats: SARS-CoV, MERS-CoV and SARS-CoV-2, **Ebola virus, Marburg virus, Nipah virus and Hendra virus.** The **agents** vectored by bats constitute some of the most feared, difficult and persistent problems affecting human health. While these viruses are highly pathogenic in humans and other animals, the bats that host them do not experience **meaningful pathology.** Further, there is increasing evidence that many other human viruses may have originated in bats, including measles, mumps and hepatitis C

This is the name of a new facility at CSU where disease-free bats will be available to scientists from across the nation for research.

The building will include multiple, self-closing doors between the outside and areas where bats are contained, as well as proper ventilation controls.

Zoonotic viruses are viruses that spread between animals and people and can make people sick.

CSU does not and will not have these pathogens on any of its campuses. These pathogens require the highest level of biosafety in a laboratory; CSU does not have laboratories with those capabilities. Research on these pathogens takes place in other states with specially equipped laboratories.

"Agent" is another word for viruses, bacteria and micro-organisms.

In this context, "pathology" means "disease." In other words, bats don't get sick from viruses like people and other animals do.

viruses. While the study of bats as **reservoir hosts** for these zoonotic agents has intensified over the last 10 years, our understanding of viral tolerance in bat reservoirs remains largely unknown. Improving our understanding of viral tolerance in bats can improve our understanding and outcomes of humans infected with bat-origin zoonoses. However, there is a lack of facilities capable of maintaining them in the laboratory setting to conduct these critical studies. In 1984, Colorado State University (CSU) established the Center for Vector-borne Infectious Disease as a visionary approach to counter these emerging threats. Since its creation, CVID has been an internationally recognized resource advancing science, practice and training on topics related to vector borne infectious disease. **One of the many unique aspects of CVID includes having one of the only captive breeding colonies of bats (Jamaican fruit bats, *Artibeus jamaicensis*) for use in infectious disease research, which has been in place for nearly six years.**

This proposal outlines requests for funds to construct a **bat vivarium** to establish a Bat Resource Center to breed and maintain these important **models** for investigators at a regional and national level. The goals of this project are to: 1) Construct a state-of-the-art 14,000 SF bat vivarium with the necessary environmental and biosafety controls to promote successful breeding and rearing of bats for use as research models, and 2) Accommodate a growing research agenda and national need in emerging bat-borne and bat-associated diseases.

Our approach to accomplish these goals within the vivarium are as follows: 1) establish six temperature, **photoperiod and humidity-controlled rooms** to house bat colonies for breeding. Three **large (1500 SF) rooms** with adjoining procedure space to house

Reservoir hosts are animals that carry a virus and serve as a source of infection for other animals and people.

CSU has been researching infectious diseases and bats for years. Bats currently live in one of our research buildings for the purposes of these studies. They have lived in this building for more than 15 years.

Vivarium is another word for nursery.

Bats are referred to as models here because this small number of bats provide examples of how other bats respond to infectious pathogens, "modeling" how other bats would respond.

Bats held in the vivarium will be from various regions across the world. These rooms will provide them with optimal light, temperatures and humidity that mimics their natural environments.

Bats in the vivarium would be provided with large spaces where they can free-fly as they would in their natural environments.

Indian flying fox (*Pteropus medius*) breeding colonies, two rooms (315 SF) with adjoining procedure and isolation space to house Jamaican fruit bat breeding colonies, and one room (315 SF) with adjoining procedure and isolation space to house horseshoe bats (*Rhinolophus affinis*). There is an additional suite to house future species of bats such as the big brown bat (*Eptesicus fuscus*) or Seba's short-tailed bat (*Carollia perspicillata*). One suite (625 SF) with two individual holding rooms, a procedure room and an isolation room to house bats for **infectious challenge studies** at **ABSL2 level**. All procedure spaces contain a biological safety cabinet for experimental manipulations. 3) One room (315 SF) dedicated to medical care for the bats. 4) a large kitchen (189 SF) with a walk-in cooler (122 SF) for food storage and preparation.

Timeline:

The estimated time to complete the facility will be 4 years (July 2024).

The proposed building will support our existing research programs and collaborations and allow them to continue to expand. More importantly, these colonies will serve as a unique emerging national resource for studies of diseases of bat origin for other investigators that require bats for their research projects (see letters of support).

A challenge study is when researchers expose the bat to an infectious virus in a highly controlled experiment. The experiment is conducted in an isolation room, which keeps the bats isolated from other bats and has specialized biosafety controls to prevent the virus from escaping into the rest of the building or environment. When working in isolation rooms, scientists must follow very specific protocols to ensure they also are not exposed to the virus.

ABSL2 is Animal Biosafety Laboratory 2. This is a level of biosafety that is required for certain scientific experiments with pathogens. Low-risk pathogens can be used in biosafety level 2 buildings. The highest biosafety level is a level 4. CSU has BSL2 and BSL3 laboratories on its campuses, but does not have BSL4 labs, where research on the highest risk pathogens takes place.