SUMMARY STATEMENT

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(Privileged Communication)

Release Date: **07/03/2021**
Revised Date:

Application Number: **1 C06 OD032019-01**

Principal Investigator

EBEL, GREGORY DAVID

Applicant Organization: COLORADO STATE UNIVERSITY

Review Group: **STOD**
Scientific and Technical Review Board on Biomedical and Behavioral Research Facilities

Meeting Date: **06/17/2021**
Council: **AUG 2021**
Requested Start: **10/01/2021**

RFA/PA: **PAR21-139**
PCC: **CON1**

Dual IC(s): **RI**

Project Title: **Establishment of the Bat Resource Center for the Study of Zoonotic Diseases**

SRG Action: **Impact Score** (b)(5); (b)(6)
Next Steps: **Visit https://grants.nih.gov/grants/next_steps.htm**
Human Subjects: (b)(5); (b)(6) **No human subjects involved**
Animal Subjects: **No live vertebrate animals involved for competing appl.**

Project Year	Direct Costs Requested	Estimated Total Cost
1	0	0
TOTAL	0	0

ADMINISTRATIVE BUDGET NOTE: The budget shown is the requested budget and has not been adjusted to reflect any recommendations made by reviewers. If an award is planned, the costs will be calculated by Institute grants management staff based on the recommendations outlined below in the COMMITTEE BUDGET RECOMMENDATIONS section.

1C06OD032019-01 Ebel, Gregory

RESUME AND SUMMARY OF DISCUSSION: This C06 application in response to PAR21-139 seeks to establish the Bat Resource Center at Colorado State University via construction of (b)(4) square feet of bat vivarium. This is one of only two facilities in the United States that house bats for study of zoonotic diseases, a topic that is certainly timely. The research involved is generally excellent, though at present there are few external grants to CSU faculty in this area. Thus there is concern about the likelihood that the renovation will be critical for attracting new funding. There are opportunities for collaborations with other agencies (e.g., the NIAID Regional Rocky Mountain Laboratory). The project team is excellent, there is strong institutional support, and the facility design is outstanding. An important (non-trivial) feature is that permits for importing the bats are in place. A concern was raised regarding the containment level of the lab; this is to be BSL-2, and it is not evident how it can be upgraded to BSL-3 as implied the application. All in all, the effort is expected to have high impact in a critical area.

DESCRIPTION (provided by applicant): This proposal outlines 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 Vectorborne 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.

CRITIQUE 1

Scientific Merit/Organization: 1
Admin/Leadership: 1
Anticipated Effect: 1
Need for Project/Space: 1
Project Design: 1

Overall Impact: This is an exceptional, novel, and very timely proposal from Colorado State University (CSU) to construct a specialized vivarium to breed and maintain multiple bat species that serve as hosts for zoonotic diseases, especially RNA viruses including SARS-CoV-2, the causative agent of the current COVID-19 pandemic. It was a pleasure to read this well-crafted and cogent application.

Major strengths of the proposal include: the strong scientific merit of the proposed resource and the national need to support research on bats as hosts of emerging diseases. There is a lack of facilities for maintaining bat colonies in a laboratory setting to elucidate how bats serve as hosts for infectious agents but do not develop disease themselves, and to provide animals for studies on infection transmission and bat immunity. CSU has for many years been at the center of zoonotic disease research. The leadership team is highly qualified with expertise both in bat research and building research facilities. There is strong institutional support for the project. The vivarium will provide important opportunities to interact regionally with the NIAID Rocky Mountain Labs and the Rocky Mountain Regional Biocontainment Lab.

The application has no significant weaknesses.

1. Scientific Merit and Organization of the Total Program and Its Component Parts to be Carried Out in the Facility

Strengths

- CSU has recently invested in a new Center for Vectorborne and Infectious Disease (CVID) building to support this area of research. There are currently nine faculty members with meritorious research programs in the field.
- Given the establishment and ongoing maintenance of a Jamaican fruit bat colony, only one of two captive bat colonies in the US (the other being at the CDC), there is every reason to expect that the proposed program will be well coordinated and managed.
- The new bat vivarium, once established, will facilitate hiring additional investigators to the institution with expertise in bat biology and infectious diseases.

Weaknesses

- None noted.

2. Administrative and Leadership Capabilities of the Applicant's Officers and Staff

Strengths

- The Principal Investigator (PI), Dr. Gregory Ebel, is the Director of the Center for Vectorborne and Infectious Disease, DVID, at CSU and is an experienced arbovirologist. He is well qualified to lead the project. The co-I, (b)(6) is a bat specialist whose expertise will be central to the success of the proposed construction project.
- The other key members of the team include (b)(6) the attending veterinarian, who has substantial experience with vivarium construction and renovation. The project manager, (b)(6) (b)(6) works for CSU Facilities Management and has overseen multiple construction projects for the university.
- There is strong institutional support for the proposal.

Weaknesses

- None noted.

3. Anticipated Effect of the Project on Other Relevant Research Programs and Facilities in the Geographic Area and Nationwide

Strengths

- There are currently only two captive bat breeding colonies in the US – one at CDC and the other at CSU in the Center for Vectorborne and Infectious Disease. The proposed bat vivarium will serve as a resource for investigators both in the region (e.g., NIAID Rocky Mountain Laboratory) and nationally. Given the increasing focus on bats as hosts of zoonotic diseases, such as NIAID's recently released PAR-21-184 focusing on bat immunology, this unique resource will have national impact on this important area of infectious disease research.

Weaknesses

- None noted.

4. Need for the Project or Additional Space

Strengths

- There are over 1400 species of bats that comprise about 20% of all mammalian species, and there is increasing focus on bats as hosts of numerous human diseases, especially RNA viruses, including SARS-CoV-2, the causative agent of the current COVID-19 pandemic.
- There is a lack of facilities for maintaining bat colonies in a laboratory setting both to elucidate how bats serve as hosts for infectious agents but do not develop disease themselves and to provide animals for studies on infection transmission.
- CSU has a long institutional history of excellence in zoonotic and infectious disease research and resources, which makes it an ideal location for the new bat vivarium.
- The requested fixed equipment is central to the function of the vivarium, including substantial refrigeration space for fruit used to feed bats.

Weaknesses

- None noted.

5. Project Design

Strengths

- The line drawings are clearly presented, easily read, and the layout of housing, procedures and support space is logical and appropriate.
- Fig. 10 is particularly enlightening showing bat habitat netting for pteropus bats to provide for species-typical behavior characteristic of this large species.
- The engineering and architectural criteria are clearly explained, including environmental conditions appropriate for bats.

Weaknesses

- None noted.

Budget and Period of Support

- The budget is well-justified and is appropriate, including the request for fixed equipment, for the scope of the project. The period of support (3 years from award) is reasonable. The actual time for construction is estimated to be 12 months.

CRITIQUE 2

Scientific Merit/Organization: 4
Admin/Leadership: 3
Anticipated Effect: 4
Need for Project/Space: 4
Project Design: 3

Overall Impact: Overall enthusiasm for this application is noted as high to very high on the referenced scale. The scientific basis of the project is very relevant to research efforts in the current global pandemic and what are believed to be its origins. Investigators and project management team are very well qualified to implement and maintain this project. Expanding the facility will further enhance research on campus and position CSU as a central facility among only a few others in the country. Project design plans are well executed and address the needs noted in the application.

1. Scientific Merit and Organization of the Total Program and Its Component Parts to be Carried Out in the Facility

Strengths

- Expansion of the vivarium will create/enhance the facility as a national resource for diseases of bat origin.
- The research description makes a clear point of the possibility that this research could have a direct impact on the ongoing global pandemic.

Weaknesses

- None identified.

2. Administrative and Leadership Capabilities of the Applicant's Officers and Staff

Strengths

- The scientific and project management teams are well-qualified to operate, deliver, and maintain the facility.
- Budget and project schedule are reasonable and within cost and timeframe norms for similar buildings.

Weaknesses

- Operating and maintenance budget allocation is not apparent.

3. Anticipated Effect of the Project on Other Relevant Research Programs and Facilities in the Geographic Area and Nationwide

Strengths

- Expansion of this facility will create/enhance the facility as a national resource for diseases of bat origin.
- The application notes the campus need for this specific facility, along with national collaborators.
- The project will further enhance a major research component of this institution.

Weaknesses

- None noted.

4. Need for the Project or Additional Space

Strengths

- The applicant clearly notes increased need on the campus for more bats for research purposes.
- The new building is well situated on the existing campus near other support facilities that it will need.

Weaknesses

- Needs of existing staff and specific numbers related to space needed are not quantified in the application.

5. Project Design

Strengths

- Project design is well documented with a clear and concise plan to accommodate the new bat housing facility.
- Major equipment is appropriately indicated on drawings and in detail in the application document.
- Engineering systems for the new building are aptly specified and will address the infrastructure needs for this building.
- Sustainability efforts are identified and are reasonable for a building of this size and function.

Weaknesses

- As this is a small separate building and no future space is identified, if the need keeps growing there might not be a logical space into which to expand if not planned into this new building.

Budget and Period of Support

- No comment provided by reviewer

CRITIQUE 3

Scientific Merit/Organization: 3
Admin/Leadership: 1
Anticipated Effect: 5
Need for Project/Space: 6
Project Design: 1

Overall Impact: This proposal outlines a request to establish the Bat Resource Center for the Study of Zoonotic Diseases at Colorado State University. The proposal will construct a Bat Resource Center (b)(4) gross square feet (gsf) vivarium to house various bat species, located adjacent to the Center for Vectorborne Disease and the Rocky Mountain Regional Biocontainment Laboratory. It is uniquely designed 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 that involved in 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.

1. Scientific Merit and Organization of the Total Program and Its Component Parts to be Carried Out in the Facility

Strengths

- The proposed building will support existing research programs and collaborations with diverse research programs that study diseases of bat origin and related projects.
- CVID is well recognized for advancing science, including COVID-19 research
- CSU has one of the only two US-based breeding colonies of bats for study of infectious diseases.

Weaknesses

- Current external funding is limited but the new animals are postulated to foster an increase in the number of grants received. The facility and expertise are unique.

2. Administrative and Leadership Capabilities of the Applicant's Officers and Staff

Strengths ,

- Greg Ebel is the Director of the Center of Vectorborne Diseases and oversaw the construction and design of the $22M CVID facility

Weaknesses

- None noted

3. Anticipated Effect of the Project on Other Relevant Research Programs and Facilities in the Geographic Area and Nationwide

Strengths

- The PI describes many ongoing projects and collaborations.
- Develop cell lines and perform experimental infections.

Weaknesses

- Future expansion is rationalized as follows: if the bats become available then external agencies will provide support for sustaining the colonies.
- (b)(4); (b)(6); Pending Support
- Unique national resource

4. Need for the Additional Space

Strengths

- Many emerging diseases are possibly naturally harbored by bats.

Weaknesses

- It is unclear how the expansion of the bat colony will specifically impact ongoing research (~$3M).

5. Project Design

Strengths

- Design is efficient, clear, and well planned.

Weaknesses

- None noted. Isolation space may be limited for unique colonies.

Budget and Period of Support

- Acceptable

THE FOLLOWING SECTIONS WERE PREPARED BY THE SCIENTIFIC REVIEW OFFICER TO SUMMARIZE THE OUTCOME OF DISCUSSIONS OF THE REVIEW COMMITTEE, OR REVIEWERS' WRITTEN CRITIQUES, ON THE FOLLOWING ISSUES:

COMMITTEE BUDGET RECOMMENDATIONS: The budget was recommended as requested.

Footnotes for 1 C06 OD032019-01; PI Name: Ebel, Gregory David

NIH has modified its policy regarding the receipt of resubmissions (amended applications).See Guide Notice NOT-OD-18-197 at https://grants.nih.gov/grants/guide/notice-files/NOT-OD-18-197.html. The impact/priority score is calculated after discussion of an application by averaging the overall scores (1-9) given by all voting reviewers on the committee and multiplying by 10. The criterion scores are submitted prior to the meeting by the individual reviewers assigned to an application, and are not discussed specifically at the review meeting or calculated into the overall impact score. Some applications also receive a percentile ranking. For details on the review process, see http://grants.nih.gov/grants/peer_review_process.htm#scoring.

MEETING ROSTER

Scientific and Technical Review Board on Biomedical and Behavioral Research Facilities
OFFICE OF THE DIRECTOR, NATIONAL INSTITUTES OF HEALTH
STOD
06/17/2021 - 06/18/2021

Notice of NIH Policy to All Applicants: Meeting rosters are provided for information purposes only. Applicant investigators and institutional officials must not communicate directly with study section members about an application before or after the review. Failure to observe this policy will create a serious breach of integrity in the peer review process, and may lead to actions outlined in NOT-OD-14-073 at https://grants.nih.gov/grants/guide/notice-files/NOT-OD-14-073.html, NOT-OD-15-106 at https://grants.nih.gov/grants/guide/notice-files/NOT-OD-15-106.html, and NOT-OD-18-115 at https://grants.nih.gov/grants/guide/notice-files/NOT-OD-18-115.html, including removal of the application from immediate review.

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* Temporary Member. For grant applications, temporary members may participate in the entire meeting or may review only selected applications as needed.

Consultants are required to absent themselves from the room during the review of any application if their presence would constitute or appear to constitute a conflict of interest.

Department of Health and Human Services
National Institutes of Health
OFFICE OF THE DIRECTOR, NATIONAL INSTITUTES OF HEALTH

Notice of Award
FAIN# C06OD032019
Federal Award Date
08-25-2022

Recipient Information

1. Recipient Name
COLORADO STATE UNIVERSITY
601 S HOWES ST

FORT COLLINS, 80521

2. Congressional District of Recipient
02

3. Payment System Identifier (ID)
1846000545A1

4. Employer Identification Number (EIN)
846000545

5. Data Universal Numbering System (DUNS)
785979618

6. Recipient's Unique Entity Identifier
LT9CXX8L19G1

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8. Authorized Official
Liz Grinstead

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9. Awarding Agency Contact Information
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10. Program Official Contact Information
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Federal Award Information

11. Award Number
1C06OD032019-01

12. Unique Federal Award Identification Number (FAIN)
C06OD032019

13. Statutory Authority
42 USC 283k 42 CFR 52b

14. Federal Award Project Title
Establishment of the Bat Resource Center for the Study of Zoonotic Diseases

15. Assistance Listing Number
93.352

16. Assistance Listing Program Title
Construction Support

17. Award Action Type
New Competing (REVISED)

18. Is the Award R&D?
Yes

Summary Federal Award Financial Information

19. Budget Period Start Date 09-20-2021 **– End Date** 05-31-2026	
20. Total Amount of Federal Funds Obligated by this Action	$0
20 a. Direct Cost Amount	$0
20 b. Indirect Cost Amount	$0
21. Authorized Carryover	
22. Offset	
23. Total Amount of Federal Funds Obligated this budget period	$6,748,541
24. Total Approved Cost Sharing or Matching, where applicable	$0
25. Total Federal and Non-Federal Approved this Budget Period	$6,748,541
26. Project Period Start Date 09-20-2021 **– End Date** 05-31-2026	
27. Total Amount of the Federal Award including Approved Cost Sharing or Matching this Project Period	$6,748,541

28. Authorized Treatment of Program Income
Other (See Remarks)

29. Grants Management Officer - Signature
Gavin Wilkom

30. Remarks

Acceptance of this award, including the "Terms and Conditions," is acknowledged by the recipient when funds are drawn down or otherwise

requested from the grant payment system.

RESEARCH FACILITIES CONSTRUCTION
Department of Health and Human Services
National Institutes of Health

OFFICE OF THE DIRECTOR, NATIONAL INSTITUTES OF HEALTH

SECTION I – AWARD DATA – 1C06OD032019-01 REVISED

Principal Investigator(s):
Gregory David Ebel, SCD

Award e-mailed to: SP@research.colostate.EDU

Dear Authorized Official:

The National Institutes of Health hereby revises this award (see "Award Calculation" in Section I and "Terms and Conditions" in Section III) to COLORADO STATE UNIVERSITY in support of the above referenced project. This award is pursuant to the authority of 42 USC 283k 42 CFR 52b and is subject to the requirements of this statute and regulation and of other referenced, incorporated or attached terms and conditions.

Acceptance of this award, including the "Terms and Conditions," is acknowledged by the recipient when funds are drawn down or otherwise requested from the grant payment system.

Each publication, press release, or other document about research supported by an NIH award must include an acknowledgment of NIH award support and a disclaimer such as "Research reported in this publication was supported by the Office Of The Director, National Institutes Of Health of the National Institutes of Health under Award Number C06OD032019. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health." Prior to issuing a press release concerning the outcome of this research, please notify the NIH awarding IC in advance to allow for coordination.

Award recipients must promote objectivity in research by establishing standards that provide a reasonable expectation that the design, conduct and reporting of research funded under NIH awards will be free from bias resulting from an Investigator's Financial Conflict of Interest (FCOI), in accordance with the 2011 revised regulation at 42 CFR Part 50 Subpart F. The Institution shall submit all FCOI reports to the NIH through the eRA Commons FCOI Module. The regulation does not apply to Phase I Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) awards. Consult the NIH website http://grants.nih.gov/grants/policy/coi/ for a link to the regulation and additional important information.

If you have any questions about this award, please direct questions to the Federal Agency contacts.

Sincerely yours,

Gavin Wilkom
Grants Management Officer
OFFICE OF THE DIRECTOR, NATIONAL INSTITUTES OF HEALTH

Additional information follows

Cumulative Award Calculations for this Budget Period (U.S. Dollars)

Construction Costs	$6,551,991
Equipment or Facility Rental/User Fees	$196,550
Federal Direct Costs	$6,748,541
Construction and Related Costs (Approved Budget)	$6,748,541
Total Amount of Federal Funds Authorized (Federal Share)	$6,748,541
TOTAL FEDERAL AWARD AMOUNT	$6,748,541
AMOUNT OF THIS ACTION (FEDERAL SHARE)	$0

SUMMARY TOTALS FOR ALL YEARS (for this Document Number)		
YR	**THIS AWARD**	**CUMULATIVE TOTALS**
1	$6,748,541	$6,748,541

Fiscal Information:

Payment System Identifier:	1846000545A1
Document Number:	COD032019A
PMS Account Type:	P (Subaccount)
Fiscal Year:	2021

IC	CAN	2021
OD	8041979	$6,748,541

NIH Administrative Data:
PCC: CON1 / **OC**: 41001 / **Released**: Wilkom, Gavin 08-24-2022
Award Processed: 08/25/2022 12:02:15 AM

SECTION II – PAYMENT/HOTLINE INFORMATION – 1C06OD032019-01 REVISED

For payment and HHS Office of Inspector General Hotline information, see the NIH Home Page at http://grants.nih.gov/grants/policy/awardconditions.htm

SECTION III – STANDARD TERMS AND CONDITIONS – 1C06OD032019-01 REVISED

This award is based on the application submitted to, and as approved by, NIH on the above-titled project and is subject to the terms and conditions incorporated either directly or by reference in the following:

a. The grant program legislation and program regulation cited in this Notice of Award.
b. Conditions on activities and expenditure of funds in other statutory requirements, such as those included in appropriations acts.
c. 45 CFR Part 75.
d. National Policy Requirements and all other requirements described in the NIH Grants Policy Statement, including addenda in effect as of the beginning date of the budget period.
e. Federal Award Performance Goals: As required by the periodic report in the RPPR or in the final progress report when applicable.
f. This award notice, INCLUDING THE TERMS AND CONDITIONS CITED BELOW.

(See NIH Home Page at http://grants.nih.gov/grants/policy/awardconditions.htm for certain

references cited above.)

Research and Development (R&D): All awards issued by the National Institutes of Health (NIH) meet the definition of "Research and Development" at 45 CFR Part§ 75.2**.** As such, auditees should identify NIH awards as part of the R&D cluster on the Schedule of Expenditures of Federal Awards (SEFA). The auditor should test NIH awards for compliance as instructed in Part V, Clusters of Programs. NIH recognizes that some awards may have another classification for purposes of indirect costs. The auditor is not required to report the disconnect (i.e., the award is classified as R&D for Federal Audit Requirement purposes but non-research for indirect cost rate purposes), unless the auditee is charging indirect costs at a rate other than the rate(s) specified in the award document(s).

This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VII Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots.

Carry over of an unobligated balance into the next budget period requires Grants Management Officer prior approval.

MULTI-YEAR FUNDED AWARD: This is a multi-year funded award. A progress report is due annually on or before the anniversary of the budget/project period start date of the award, in accord with the instructions posted at: http://grants.nih.gov/grants/policy/myf.htm.

This award is subject to the requirements of 2 CFR Part 25 for institutions to obtain a unique entity identifier (UEI) and maintain an active registration in the System for Award Management (SAM). Should a consortium/subaward be issued under this award, a UEI requirement must be included. See http://grants.nih.gov/grants/policy/awardconditions.htm for the full NIH award term implementing this requirement and other additional information.

This award has been assigned the Federal Award Identification Number (FAIN) C06OD032019. Recipients must document the assigned FAIN on each consortium/subaward issued under this award.

Based on the project period start date of this project, this award is likely subject to the Transparency Act subaward and executive compensation reporting requirement of 2 CFR Part 170. There are conditions that may exclude this award; see http://grants.nih.gov/grants/policy/awardconditions.htm for additional award applicability information.

In accordance with P.L. 110-161, compliance with the NIH Public Access Policy is now mandatory. For more information, see NOT-OD-08-033 and the Public Access website: http://publicaccess.nih.gov/.

This award represents the final year of the competitive segment for this grant. See the NIH Grants Policy Statement Section 8.6 Closeout for complete closeout requirements at: http://grants.nih.gov/grants/policy/policy.htm#gps.

A final expenditure Federal Financial Report (FFR) (SF 425) must be submitted through the eRA Commons (Commons) within 120 days of the period of performance end date; see the NIH Grants Policy Statement Section 8.6.1 Financial Reports, http://grants.nih.gov/grants/policy/policy.htm#gps, for additional information on this submission requirement. The final FFR must indicate the exact balance of unobligated funds and may not reflect any unliquidated obligations. There must be no discrepancies between the final FFR expenditure data and the Payment Management System's (PMS) quarterly cash transaction data. A final quarterly federal cash transaction report is not required for awards in PMS B subaccounts (i.e., awards to foreign entities and to Federal agencies). NIH will close the awards using the last recorded cash drawdown level in PMS for awards that do not require a final FFR on expenditures or quarterly federal cash transaction reporting. It is important to note that for financial closeout, if a grantee fails to submit a required final expenditure FFR, NIH will close the grant using the last recorded cash drawdown level. If the grantee submits a final expenditure FFR but does not reconcile any discrepancies between expenditures

reported on the final expenditure FFR and the last cash report to PMS, NIH will close the award at the lower amount. This could be considered a debt or result in disallowed costs.

A Final Invention Statement and Certification form (HHS 568), (not applicable to training, construction, conference or cancer education grants) must be submitted within 120 days of the expiration date. The HHS 568 form may be downloaded at: http://grants.nih.gov/grants/forms.htm. This paragraph does not apply to Training grants, Fellowships, and certain other programs—i.e., activity codes C06, D42, D43, D71, DP7, G07, G08, G11, K12, K16, K30, P09, P40, P41, P51, R13, R25, R28, R30, R90, RL5, RL9, S10, S14, S15, U13, U14, U41, U42, U45, UC6, UC7, UR2, X01, X02.

Unless an application for competitive renewal is submitted, a Final Research Performance Progress Report (Final RPPR) must also be submitted within 120 days of the period of performance end date. If a competitive renewal application is submitted prior to that date, then an Interim RPPR must be submitted by that date as well. Instructions for preparing an Interim or Final RPPR are at: https://grants.nih.gov/grants/rppr/rppr_instruction_guide.pdf. Any other specific requirements set forth in the terms and conditions of the award must also be addressed in the Interim or Final RPPR. *Note that data reported within Section I of the Interim and Final RPPR forms will be made public and should be written for a lay person audience*.

NIH strongly encourages electronic submission of the final invention statement through the Closeout feature in the Commons, but will accept an email or hard copy submission as indicated below.

Email: The final invention statement may be e-mailed as PDF attachments to: NIHCloseoutCenter@mail.nih.gov.

Hard copy: Paper submissions of the final invention statement may be faxed to the NIH Division of Central Grants Processing, Grants Closeout Center, at 301-480-2304, or mailed to:

National Institutes of Health
Office of Extramural Research
Division of Central Grants Processing
Grants Closeout Center
6705 Rockledge Drive
Suite 5016, MSC 7986
Bethesda, MD 20892-7986 (for regular or U.S. Postal Service Express mail)
Bethesda, MD 20817 (for other courier/express deliveries only)

NOTE: If this is the final year of a competitive segment due to the transfer of the grant to another institution, then a Final RPPR is not required. However, a final expenditure FFR is required and should be submitted electronically as noted above. If not already submitted, the Final Invention Statement is required and should be sent directly to the assigned Grants Management Specialist.

In accordance with the regulatory requirements provided at 45 CFR 75.113 and Appendix XII to 45 CFR Part 75, recipients that have currently active Federal grants, cooperative agreements, and procurement contracts with cumulative total value greater than $10,000,000 must report and maintain information in the System for Award Management (SAM) about civil, criminal, and administrative proceedings in connection with the award or performance of a Federal award that reached final disposition within the most recent five-year period. The recipient must also make semiannual disclosures regarding such proceedings. Proceedings information will be made publicly available in the designated integrity and performance system (currently the Federal Awardee Performance and Integrity Information System (FAPIIS)). Full reporting requirements and procedures are found in Appendix XII to 45 CFR Part 75. This term does not apply to NIH fellowships.

Treatment of Program Income:
Other (See Remarks)

Clinical Trial Indicator: No
This award does not support any NIH-defined Clinical Trials. See the NIH Grants Policy Statement Section 1.2 for NIH definition of Clinical Trial.

REVISION #1:
CHANGE IN SCOPE
This revision reflects ORIP's approval to change the scope of work from the original application, as requested in the grantee's letter dated 08/18/2022. The scope has been modified as follows: The overall square footage of the base-bid design has been reduced from (b)(4) GSF to (b)(4)

The below terms and conditions remain in effect.

SUBJECT FOA
This award is subject to the conditions set forth in PAR-21-139, "Biomedical Research Facilities," which are hereby incorporated by reference as special terms and conditions of this award. Copies of this Funding Opportunity Announcement can be found at the following link:PAR-21-139: Biomedical Research Facilities (C06 Clinical Trial Not Allowed) (nih.gov)

COMMUNICATION REQUIREMENTS
All communications outside the design submission process noted below must be submitted by an Authorized Organization Representative to your Grants Management Specialist and Program Official in order to be considered official communication. Any prior approval request or correspondence NOT submitted to your Grants Management Specialist and Program Official will not be considered or approved.

FUNDS RESTRICTION
All funds except allowable design costs are RESTRICTED and may not be obligated. Funds will be released ONLY through the issuance of a revised Notice of Award (NoA) as negotiated milestones are met or required approvals are obtained. Until the NoA is revised, you may not obligate any funds beyond the allowable design costs. Unauthorized use of restricted funds will result in cost disallowance.

FUNDS EXPIRATION
All funds MUST be expended within 56 months from the date of the initial award. Any extension of the budget and/or project period end dates WILL NOT be permitted under Expanded Authorities or by NIH staff.

FOR 5 YEAR MULTI-YEAR FUNDED AWARDS
Due to the expiration of funds in keeping with Public Law 101-510, this award's end date is May 31, 2026 to provide the awardee with sufficient time to complete the close out process. Public Law 101-510 limits the availability of funds to five fiscal years after the original obligation. Funds awarded expire on May 31, 2026 and will not be available for draw-down in the Payment Management System (PMS). Any funds drawn down after May 31, 2026 will need to be returned.

USAGE OF SPACE
The space created and/or renovated under this award must be used in support of the ORIP approved biomedical research activities for which it was constructed for 20 years after beneficial occupancy unless otherwise approved by the NIH/ORIP Program and Grants Management Officials. The ORIP-funded space will include research and research support areas as follows:

Summary of Research Space Area (n.s.f): (b)(4)
Total Cost ORIP Cost: $6,748,541
Establishment of the Bat Resource Center for the Study of Zoonotic Diseases

ALTERNATE CONTRACTING METHODS

NHLBI/ORIP considers the figures supplied in the application or just-in-time information to be estimates for the purposes of preparing a budget submission. Should the grantee be interested in using a contracting method other than Design-Bid-Build, prior approval from NIH will be required prior to the use of the alternate contracting method, per the Grants Policy Statement, 10.3.2: https://grants.nih.gov/grants/policy/nihgps/HTML5/section_10/10.3.2_alternate_contracting_methods.htm?Highlight=CM

Requirements for Construction Manager-at-Risk, Design-Build Services and Guaranteed Maximum Price are also highlighted in this section.

NEPA
Due to the nature of this project, NIH requires that the grantee follow the National Environmental Policy Act (NEPA requirements). The preparation of an Environmental Impact Statement and/or Environmental Analysis is the responsibility of the grantee; However, NIH is responsible for the complete review, recommendation, and approval of the process and reports.

The ORIP will assist the grantee in carrying out the required procedures. The grantee is also required to publicly disclose the project in the newspaper or other publicly available medium and to describe its environmental impact.

COSTING
The total eligible design, construction, fixed equipment costs, and Final Cost Allocation Ratio shall be in accordance with the Final Design Documents as determined from the lowest acceptable competitive construction bid(s), and approved by the NIH/ORIP Program and Grants Management Officials. The grantee shall identify the costs of the grant-supported areas to the satisfaction of NIH/ORIP Program and Grants Management Officials. Awarded contingency funds are limited to 15 percent of the total allowable costs at the time of award. Once a construction contract has been awarded, the portion of the contingency fee over 10 percent of the total allowable costs in the contract budget shall be borne by the grantee.

DESIGN PHASE
The grantee must initiate the design phase of the project immediately following return of the signed Terms and Conditions document. The grantee must complete the development of the construction documents (CD) no later than 16 months following the issue date of the notice of grant award (NoA). Four to six weeks are required for the review of each design submission. All design documents must be approved by the NIH/ORIP Program and Grants Management Officials and the following approval schedule must be followed:

Schematic Design (35% complete): 4 months following the release of the NoA
Design Development (65% complete): 10 months following the release of the NoA
Construction Document (95-100% complete): 16 months following the release of the NoA

The NIH recommends sending the Final Record Documents (FRD) as soon as possible following the technical review and approval of the 100% complete CD submission. It is important to note that the NIH WILL NOT revise the NoA to release restricted award funds until the FRD submission is approved.

During the design phase of the project, all design documents (such as design drawings, cost estimates and specifications, review comments, review comment responses) shall be submitted to ORIP's engineering team at oripconstruction@mail.nih.gov. ALL other grant related correspondence MUST be submitted to your Grants Management Specialist listed on this NoA.

DESIGN REQUIREMENTS
Design documents MUST meet all the requirements (without exception), outlined in the latest version of the NIH Design Requirement Manual (DRM) (available at http://orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManualPDF.aspx). The Grantee shall inform their design team prior to start of the design process that the design document submittals will be reviewed by NIH based on the DRM. The provisions of this manual are not intended to prohibit the use of alternative systems, methods, or devices that are not specifically outlined in the

document, provided that the proposed alternative design is at least equivalent or superior to the requirements in this manual with regard to such items as quality, strength, durability, effectiveness, fire resistance, health and safety, etc., and is approved during the design review process.

During the course of programming and design development, it may become necessary for Project Officers and A/E to request variances from the established minimum standards. These variances may be necessary to accommodate existing building constraints or site conditions, required technology, or the Program of Requirements. Variance forms can be found in NIH DRM.

CONTRACTING METHOD REQUIREMENTS
Procurement requirements under construction grants must follow requirements in the NIH Grants Policy Statement specifically described in Part II: 10.3 Contracting Methods. Any deviation from the Design-Bid-Build Contracting Method MUST be requested in advance and written approval from the NIH/ORIP Grants Management Staff must be received prior to beginning the process of using an alternate contracting method.

Formal advertising with open competition resulting in lump-sum, fixed price contracts is expected. Any variance from policy or employing the use of Alternate Contracting Methods requires written prior approval from the NIH/ORIP Grants Management and Program Staff.

The grantee shall notify NIH/ORIP Grants Management and Program Staff of the selection of the contractor and the date of construction commencement. The estimated date of completion of the proposed construction project is no later than May 31, 2026.

ADVERTISEMENT FOR BIDS
No advertisements for bids of any kind may be published until the NoA is revised to release funds after the final Construction Document is approved or unless written approval from NIH/ORIP Grants Management Staff has been given. Contracts and other binding arrangements for the construction or renovation of the grant-supported space must be effective no later than 6 months from the date of the release of funds through a revised NoA.

NOTICE OF FEDERAL INTEREST
In accordance with 45 CFR Part 74.37, the grantee must record a Notice of Federal Interest at the time construction begins. A copy of the recorded Notice must be sent to the Grants Management Specialist identified below within 10 days of recordation.

MULTI-YEAR FUNDED PROGRESS REPORT
You will be required to submit an annual Multi-year Funded (MYF) progress report during the life of this grant. You will find instructions on this webpage: http://grants.nih.gov/grants/policy/myf.htm

SITE VISITS
NIH/ORIP Program and Grants Management Officials reserve the right to conduct site visits at any time to oversee the project status.

COMPLETION
An authorized organization representative of the grantee must notify the Grants Management Specialist identified below immediately upon completion of the construction project or beneficial occupancy, whichever comes first, to initiate the closeout procedures applicable to this award.

INSURANCE
Immediately upon completion of the project or beneficial occupancy, whichever comes first, the grantee must purchase an insurance policy which protects the property against partial or total physical destruction. The policy must cover the full appraised value of the property (not just the Federal portion thereof), using state-certified appraisers. The insurance policy is to be maintained for the entire 20-year usage period. A waiver to the requirement may be considered by NIH/ORIP Program and Grants Management Officials if the grantee can show it is effectively self- insured against the risks involved.

FINAL RECORDS

Per the NIH Grants Policy Statement, Part II: 10.9 Closeout, the final record as-built construction documents are due to the ORIP, within 90 days following the completion of the project.

- Final RPPR
- Final tabulation of net assignable space under the award
- The actual area of construction per gross and net, square foot/meter
- The actual date of beneficial occupancy of the facility
- A simplified floor plan
- A final record as built construction documents

PROGRAM INCOME
Program income will be subject to the deductive alternative during the period of grant support. Proceeds from the sale or lease of grant-supported property shall be handled in accordance with the requirements of the Property Standards, as specified in 42 CFR 52b.9 and 45 CFR 74.32 or 45 CFR 92.31.

RECOVERY
The NIH/ORIP Program and Grants Management Officials will initiate recovery actions as specified in 42 CFR 52b.9 in the event these requirements are not fulfilled by the recipient institution.

RECORDS RETENTION
Records for real property shall be retained for three (3) years after final disposition of the property or until the end of the period of Federal interest whichever comes earlier.

PRESS RELEASE
If the grantee plans to issue a press release concerning the outcome of ORIP grant-supported research, it should notify Ms. Patricia Newman, ORIP Communications at 301-435-0744, in advance to allow for coordination.

The ORIP WWW home page is at http://dpcpsi.nih.gov/orip/

ACCEPTANCE REQUIRED
Written acknowledgement of receipt of this award is required. An authorized business official of the grantee institution should sign the "Acceptance of Grant Award" below. The document with an original signature must be returned to the address noted below. Also, due to COVID, please also provide an electronic copy of the signed document to the Grants Management Specialist.

ORIP Grants Management
NHLBI – ORIP Team
6705 Rockledge Drive, Suite 200F
Bethesda MD 20817

ACCEPTANCE OF GRANT AWARD
This award and all the terms and conditions to which it is subject are hereby accepted:

Authorized Organization Representative (typed name):

Signature:

Title:

Date:

SPREADSHEET SUMMARY
AWARD NUMBER: 1C06OD032019-01 REVISED

INSTITUTION: COLORADO STATE UNIVERSITY

Budget	Year 1
Construction Costs	$6,551,991
Equipment or Facility Rental/User Fees	$196,550
TOTAL FEDERAL DC	$6,748,541
TOTAL FEDERAL F&A	$0
TOTAL COST	$6,748,541

PI: **Ebel, Gregory David**	Title: Establishment of the Bat Resource Center for the Study of Zoonotic Diseases	
Received: 03/17/2021	FOA: PAR21-139	Council: 08/2021
Competition ID: FORMS-F	FOA Title: Biomedical Research Facilities (C06 Clinical Trial Not Allowed)	
1 C06 OD032019-01	Dual: RI	Accession Number: 4561899
IPF: 1725201	Organization: COLORADO STATE UNIVERSITY	
Former Number:	Department:	
IRG/SRG: STOD	AIDS: N	Expedited: N
Subtotal Direct Costs (excludes consortium F&A) Year 1: 0	Animals: N Humans: N Clinical Trial: N Current HS Code: (b)(5); (b)(6) HESC: N HFT: N	New Investigator: Early Stage Investigator:
Senior/Key Personnel:	*Organization:*	*Role Category:*
Gregory Ebel	COLORADO STATE UNIVERSITY	PD/PI
(b)(6)	COLORADO STATE UNIVERSITY	Other (Specify)-Facility manager
	Colorado State University	Other (Specify)-Project Manager
	Colorado State University	Other Professional-Scientific advisor

OMB Number: 4040-0010
Expiration Date: 12/31/2022

APPLICATION FOR FEDERAL ASSISTANCE
SF 424 (R&R)

3. DATE RECEIVED BY STATE	State Application Identifier

1. TYPE OF SUBMISSION*

❍ Pre-application ❍ Application ● Changed/Corrected Application

4.a. Federal Identifier

b. Agency Routing Number

2. DATE SUBMITTED | **Application Identifier**

c. Previous Grants.gov Tracking Number
GRANT13323795

5. APPLICANT INFORMATION

Organizational DUNS*: 7859796180000

Legal Name*: COLORADO STATE UNIVERSITY
Department:
Division:
Street1*: 2002 Campus Delivery - Sponsored Programs
Street2:
City*: Fort Collins
County:
State*: CO: Colorado
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: 80523-2002

Person to be contacted on matters involving this application
Prefix: First Name*: Liz Middle Name: Last Name*: Grinstead Suffix:
Position/Title: Senior Research Adminstrator
Street1*: 2002 Campus Delivery
Street2:
City*: Fort Collins
County:
State*: CO: Colorado
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: 80523-2002
Phone Number*: 970-491-1552 Fax Number: 970-491-6147 Email: liz.grinstead@colostate.edu

6. EMPLOYER IDENTIFICATION NUMBER *(EIN) or (TIN)** 1-846000545-A1

7. TYPE OF APPLICANT* H: Public/State Controlled Institution of Higher Education

Other (Specify):
Small Business Organization Type ❍ Women Owned ❍ Socially and Economically Disadvantaged

8. TYPE OF APPLICATION*

● New ❍ Resubmission
❍ Renewal ❍ Continuation ❍ Revision

If Revision, mark appropriate box(es).
❍ A. Increase Award ❍ B. Decrease Award ❍ C. Increase Duration
❍ D. Decrease Duration ❍ E. Other *(specify)* :

Is this application being submitted to other agencies?* ❍Yes ●No What other Agencies?

9. NAME OF FEDERAL AGENCY*
National Institutes of Health

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER
TITLE:

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT*
Establishment of the Bat Resource Center for the Study of Zoonotic Diseases

12. PROPOSED PROJECT
Start Date* Ending Date*
10/01/2021 09/30/2026

13. CONGRESSIONAL DISTRICTS OF APPLICANT
CO-002

SF 424 (R&R) APPLICATION FOR FEDERAL ASSISTANCE

14. PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR CONTACT INFORMATION

Prefix: First Name*: Gregory Middle Name: David Last Name*: Ebel Suffix:
Position/Title: Professor
Organization Name*: COLORADO STATE UNIVERSITY
Department:
Division: Microbiology, Immunology, & Pa
Street1*: 1685 Campus Delivery
Street2:
City*: Fort Collins
County:
State*: CO: Colorado
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: 80523-1685
Phone Number*: 970-491-8374 Fax Number: Email*: gregory.ebel@colostate.edu

15. ESTIMATED PROJECT FUNDING

a. Total Federal Funds Requested*	$7,999,350.00
b. Total Non-Federal Funds*	$0.00
c. Total Federal & Non-Federal Funds*	$7,999,350.00
d. Estimated Program Income*	$0.00

16.IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?*

a. YES ○ THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
DATE:

b. NO ● PROGRAM IS NOT COVERED BY E.O. 12372; OR
○ PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. By signing this application, I certify (1) to the statements contained in the list of certifications* and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances * and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)

● I agree*

** The list of certifications and assurances, or an Internet site where you may obtain this list, is contained in the announcement or agency specific instructions.*

18. SFLLL or OTHER EXPLANATORY DOCUMENTATION File Name:

19. AUTHORIZED REPRESENTATIVE

Prefix: First Name*: Julie Middle Name: Last Name*: Harvey Suffix:
Position/Title*: Research Administrator
Organization Name*: Colorado State University
Department: Office of Sponsored Programs
Division:
Street1*: 2002 Campus Delivery
Street2:
City*: Fort Collins
County:
State*: CO: Colorado
Province:
Country*: USA: UNITED STATES
ZIP / Postal Code*: 80523-2002
Phone Number*: 970-491-1560 Fax Number: 970-491-6147 Email*: julie.harvey@colostate.edu

Signature of Authorized Representative*
Julie Harvey

Date Signed*
03/17/2021

20. PRE-APPLICATION File Name:

21. COVER LETTER ATTACHMENT File Name:

424 R&R and PHS-398 Specific
Table Of Contents

OMB Number: 4040-0010
Expiration Date: 12/31/2022

Project/Performance Site Location(s)

Project/Performance Site Primary Location

❍ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:	Colorado State University
Duns Number:	7859796180000
Street1*:	200 W. Lake Street
Street2:	
City*:	Fort Collins
County:	
State*:	CO: Colorado
Province:	
Country*:	USA: UNITED STATES
Zip / Postal Code*:	80521-4593
Project/Performance Site Congressional District*:	CO-002

Additional Location(s) File Name:

Funding Opportunity Number: PAR-21-139. Received Date: 2021-03-17T11:38:48.000-04:00

OMB Number: 4040-0010
Expiration Date: 12/31/2022

RESEARCH & RELATED Other Project Information

1. Are Human Subjects Involved?* ○ **Yes** ● **No**

1.a. If YES to Human Subjects

Is the Project Exempt from Federal regulations? ○ Yes ○ No

If YES, check appropriate exemption number: _ 1 _ 2 _ 3 _ 4 _ 5 _ 6 _ 7 _ 8

If NO, is the IRB review Pending? ○ **Yes** ○ **No**

IRB Approval Date:

Human Subject Assurance Number

2. Are Vertebrate Animals Used?* ○ **Yes** ● **No**

2.a. If YES to Vertebrate Animals

Is the IACUC review Pending? ○ Yes ○ No

IACUC Approval Date:

Animal Welfare Assurance Number

3. Is proprietary/privileged information included in the application?* ○ **Yes** ● **No**

4.a. Does this project have an actual or potential impact - positive or negative - on the environment?* ○ **Yes** ● **No**

4.b. If yes, please explain:

4.c. If this project has an actual or potential impact on the environment, has an exemption been authorized or an environmental assessment (EA) or environmental impact statement (EIS) been performed? ○ Yes ○ No

4.d. If yes, please explain:

5. Is the research performance site designated, or eligible to be designated, as a historic place?* ○ **Yes** ● **No**

5.a. If yes, please explain:

6. Does this project involve activities outside the United States or partnership with international collaborators?* ○ **Yes** ● **No**

6.a. If yes, identify countries:

6.b. Optional Explanation:

	Filename
7. Project Summary/Abstract*	Project_Summary.pdf
8. Project Narrative*	Project_Narrative.pdf
9. Bibliography & References Cited	
10.Facilities & Other Resources	
11.Equipment	
12. Other Attachments	Line_Drawings.pdf Table_1.pdf Table_2.pdf Table_3.pdf Project_Timeline.pdf Budget_Justification_and_Vendor_Quotes.pdf Institutional_Support_Letter.pdf Certification_of_Title_to_Site.pdf Support_Letters.pdf

Funding Opportunity Number: PAR-21-139. Received Date: 2021-03-17T11:38:48.000-04:00

Project Summary

This proposal outlines 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 Vectorborne 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 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 and Infectious Disease (CVID) 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 (Jamacian fruit bats, *Artibeus jamaicensis*) for use in infectious disease research, which has been in place for nearly 6 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 proposal are to: 1) Construct a state-of-the-art (b)(4) SF bat vivarium with the necessary environmental and biosafety controls to promote successful breeding and rearing of bat 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 (b)(4) SF) rooms with adjoining procedure space to house Indian flying fox (*Pteropus medius*) breeding colonies, two rooms (b)(4) sf) with adjoining procedure and isolation space to house Jamaican fruit bat (*Artibeus jamaicensis)* breeding colonies, and one rooms (b)(4) 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*). 2) One suite (b)(4) 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 (Table 2). 3) One room (b)(4) SF) dedicated to **medical care for the bats**. 4) A large kitchen (b)(4) SF) with a walk-in cooler (b)(4) 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).

Scientific Justification. Bats represent 20% of all mammalian diversity, with 1,430 species, and they frequently live in close proximity to humans (Nowak and Walker, 1994; Teeling et al., 2005). They are reservoirs or suspected reservoirs of many viruses, including coronaviruses, paramyxoviruses, filoviruses and lyssaviruses (Calisher et al., 2006). In recent years, several bat-borne viruses have emerged that have caused substantial morbidity and mortality among humans. The COVID-19 pandemic is caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) that is, in all likelihood, a virus that originated in horseshoe bats (*Rhinolophus* species) that are commonly found in Asia (Chi et al., 2007). Nipah virus is a zoonotic paramyxovirus, hosted by multiple *Pteropus* species fruit bats across South and Southeast Asia, which causes a fatal encephalitis in humans (Wang and Cowled, 2015). The Indian flying fox (*Pteropus medius*) is the natural reservoir for Nipah virus in South Asia (Epstein et al., 2020). In each of these virus/reservoir host relationships, virtually no disease occurs in the bats (Baker et al., 2013c; Schountz, 2014). The World Health Organization prioritized 12 diseases for research that pose the greatest threat to human health (World Health Organization, 2021). Seven of these have evidence as a bat-borne virus including: SARS-CoV-2, Ebola virus, Marburg virus, Middle East respiratory syndrome coronavirus, SARS-CoV, Nipah virus and Hendra virus. The last WHO priority disease is "Disease X," a currently unknown pathogen that represents a serious public health threat. It is likely we will see other such viruses emerge with more frequency (Andersen et al., 2020; Dobson et al., 2020). This continuing public health threat has highlighted the critical need to study these emerging zoonotic pathogens in their natural hosts to better understand how to reduce their threat to human health.

Since its inception in 1984, the Center for Vector-borne Infectious Disease (CVID, formerly known as the Arthropod-borne and Infectious Disease Laboratory) continues to be an internationally recognized program advancing science, practice and training on topics related to vector borne infectious diseases. This has included foundational work in mosquito-borne diseases (dengue, Zika, West Nile), rodent-borne diseases (hantavirus, arenavirus) and bat-borne diseases (COVID-19, MERS). The eleven faculty members of the CVID have expertise ranging from metabolism and biochemistry to arbovirology, entomology, and bat and rodent immunology. The versatility of the CVID faculty were highlighted this past year as many pivoted their research to SARS-CoV-2 in response to the COVID-19 pandemic (Fagre et al., 2020a, 2020b; Quicke et al., 2020; Terry et al., 2020).

Figure 2. Jamaican fruit bats maintained at CSU.

CSU has one of only two US-based captive breeding colonies of bats for the study of infectious diseases. (The other is housed at the Centers for Disease Control and Prevention in Atlanta.) This colony was established at CSU in 2015 with Jamaican fruit bats (*Artibeus jamaicensis,* Figure 2), which are among the most common and largest bats in the New World and found as far north as the Florida Keys. Initial funding for this colony was provided by an NIH-supported project (Emerging Virus Disease Unit) to examine zoonotic virus transmission from bats. CSU has provided substantial institutional support for our colony, including renovation of facilities to accommodate the special needs of bats and providing staff funding and training. The initial breeding colony of 39 bats has expanded and we currently have over 200 bats in the colony. In 2018, CSU acquired an additional 400 Jamaican fruit bats which are maintained for use by the National Institutes of Allergy and Infectious Disease Rocky Mountain Laboratories. The bats are maintained by Laboratory Animal Resources (LAR) under the direction of (b)(6) LAR provides daily care and veterinary care for the colony. Since arriving at CSU there has been no reported health issues associated with the bats.

To address the need to further study bat models, CSU completed the construction and opening of the new CVID building which provides an additional three rooms (b)(4) SF) dedicated to housing small bats. This is in addition to our existing (b)(4) SF of animal holding space dedicated to our existing bat

colony. The bat holding facility in the new CVID building is designed to house bats for infectious diseases studies at an ABSL2 containment level. The CVID bat suite is part of a larger animal holding suites within the Infectious Disease Research Complex at CSU where there are eight animal holding suites adjacent to procedure and laboratory space at an ABSL3 containment level.

While our bat breeding colony has been highly successful, the significant increase in demand for bats as highly relevant animal models has expanded to different species as they become identified as reservoir hosts. For example, since 2002, three novel coronaviruses have emerged from bats that have caused significant impacts on humans: SARS-CoV, MERS-CoV and SARS-CoV-2, the etiologic agent of the ongoing COVID-19 pandemic (Anthony et al., 2017; Lau et al., 2005; Li et al., 2005; Zhou et al., 2020). It is now evident that thousands of distinct coronaviruses circulate in bats throughout the world, and that more than 100 of these are SARS-related CoV (SARS-CoV) that circulate in horseshoe bat species (Hu et al., 2017). There are 78 known species of horseshoe bats and they are found throughout Asia and Europe. Examination of ACE2 sequences from various horseshoe bat species suggests intermediate horseshoe bats (*Rhinolophus affinis*) have the most "human-like" ACE2 for spike binding. Another example is Nipah virus, a novel paramyxovirus, genetically related to Hendra virus, a bat-borne virus that had caused fatal encephalitis in humans. All outbreaks in South Asia have been linked to spillover from the Indian flying fox (*Pteropus medius*), a common peridomestic fruit bat (Hahn et al., 2014a, 2014b). Hendra virus and Nipah virus are the prototypic viruses in genus *Henipavirus*, which have been identified in several species of Old World fruit bats of the genus *Pteropus* across Australia, southeastern and south Asia, and Madagascar; the western-most extent of their range (Wang and Cowled, 2015). These findings have demonstrated the need to maintain a resource of diverse bat species to study these important zoonotic diseases.

The goal of this proposal is to construct a (b)(4) SF vivarium to house various bat species to serve as a regional and national resource to study bat-borne diseases. There will be six temperature, photoperiod and humidity-controlled rooms to house bat colonies for breeding. Three large rooms with adjoining procedure space to house Indian flying fox (*Pteropus medius*) breeding colonies, two rooms (b)(4) sf) with adjoining procedure and isolation space to house Jamaican fruit bat (*Artibeus jamaicensis)* breeding colonies, and one rooms with adjoining procedure and isolation space to house horseshoe bats (*Rhinolophus affinis*). There are 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*). In addition there are two individual holding rooms, a procedure room and an isolation room to house bats for infectious challenge studies at ABSL2 level, one room dedicated to medical care for the bats, and a dedicated kitchen with a walk-in cooler for food storage and preparation. Two additional small breeding rooms are available in the facility for future growth with other bat species.

Construction of the proposed bat facility will help meet the immediate needs of the CSU research community and our national collaborators (Table 3). Beyond investigators at CSU, this project will enhance regional and national efforts to understand the complex role of bats in virus emergence (See attached letters of support). For example, bats from our colony have been used to study virus-host associations of Tacaribe arenavirus (Ciminski et al., 2019; Cogswell-Hawkinson et al., 2012) and MERS-CoV (Munster et al., 2016) as *in vivo* models. Studies planned with collaborators at Rocky Mountain Laboratories in Hamilton MT will assess the susceptibility of bats to Nipah virus and ebolaviruses. The colony is also a valuable source of tissues and reagents for *in vitro* studies. For example, samples from our animals have been used to generate bat cells to study ebolavirus infection (Munster et al., 2016). Cells derived from our colony have been provided to eight collaborators through the US and globally. We have generated over 100 gb of transcriptome data and monoclonal antibodies to bat proteins. Moreover, we are currently generating publicly available data and reagents that will meet the needs of the broader community of researchers interested in bat-associated viruses.

Thus, these colonies will serve as a unique emerging national resource for studies of diseases of bat origin. Our expectation is that as the colonies expand, we and other investigators outside of the project will solicit funding from external agencies (e.g., NIAID, NSF, DARPA/DTRA) to provide support for sustaining the colonies. (b)(4)

(b)(4)

There are few captive bat colonies to support infectious disease research. Among them are *Rousettus aegyptiacus* at the US CDC (Schuh et al., 2017), *Eidolon helvum* in Ghana via a research group in Cambridge, UK (Baker et al., 2013a, 2013b), and *Artibeus jamaicensis* at CSU, which our group (PI (b)(6) has maintained for 15 years (9 at a previous institution, 6 at CSU)(Cogswell-Hawkinson et al., 2012). We will continue to maintain the Jamaican fruit bat colony in this new facility as we have it currently established. Jamaican fruit bats live 7-9 years, breed 2-3 times per year in captivity reaching sexual maturity by 12 months, and give birth to one pup. The additional bats to be raised in the facility include the horseshoe bats and Indian flying foxes. Horseshoe bats are long-lived (>25 years), seasonal breeders that reach sexual maturity at 2-3 years and give birth to one pup per year (Nurul-Ain et al., 2017; Rossiter et al., 2000). While CSU has some experience in maintaining insectivorous bats, we will consult with (b)(6) who has nearly 10 years of experience with captive insectivorous bat husbandry at the (b)(4) (b)(4) (see letter of support).

Indian flying foxes are listed as CITES Appendix II and are listed as of "least concern," so establishing a colony would not have negative impacts on the local populations. *Pteropus* bats are robust and have routinely bred in captivity at the Lubee Bat Conservancy. Development of the permanent colony at CSU will be guided by (b)(6) who has 24+ years of experience with captive pteropid bat husbandry (see letter of support). *Pteropus medius* are also long-lived bats (>15-20 years in captivity) and are seasonal breeders, with a gestation period of 6 months (Mathur et al., 2012). Both the horseshoe bats and the Indian flying foxes can be obtained from Bangladesh. Our collaborator, (b)(6) (see letter of support) has directly coordinated the export of *Pteropus vampyrus* from Malaysia to Australia for Nipah virus experimental studies at the Center for Disease Preparedness (formerly AAHL) and will facilitate the establishment of these colonies. These are important models and our existing infrastructure is unable to properly address their animal care needs.

The project team assembled for this proposal has a strong track record of leadership and specifically overseeing the planning and execution of construction projects. Dr. Greg Ebel is the director of the Center of Vector-borne Infectious Disease and arbovirologists. He most recently oversaw the programming, design and construction of the $22M CVID facility which was completed in fall of 2020. (b)(6) and has been involved in several animal facility improvement projects including 6 NIH G20 awards. He currently oversees the programming, design and construction of the $6.6M Bay Facility vivarium housing research animals at CSU. (b)(6) (b)(6) is nationally known for his work with bats as vectors for zoonotic disease and has established several national collaborations. He will serve as the scientific advisor to the project. (b)(6) is a Project Manager with CSU Facilities Management. She has 14 years' experience in project management including several new research buildings on the CSU campus totally more than $216M. This includes both the CVID and Bay Facilities with Drs. Ebel and (b)(6)

Development of the Facility. The proposed Bat Resource Center is sited on public property on the Foothills Campus owned by Colorado State University. The majority of the facilities located on the

Foothills Campus are dedicated to scientific research and outreach in various fields including atmospheric science, biotechnology, veterinary science and infectious disease. The proposed facility is intended to be a stand-alone structure situated adjacent to the CVID and the Infectious Disease Research Center (IDRC), where the Rocky Mountain Regional Biocontainment Laboratory (RMRBL) resides. See Figure 1 for an overview of the Foothills Campus and Figure 2 for the immediate surroundings of the proposed site. While the focus of the proposal is to construct a facility for breeding a variety of bat species and ABSL2 housing, the location is ideal for studies that require ABSL3 containment. The IDRC and RMRBL have over 10 animal rooms for conducting studies at ABSL3. Studies at ASL3 do not require large flight rooms, rather the bats are housed in cages during the studies to facilitate observations, handling and restraint. The IDRC also has a centralized cagewash facility which will support the bat vivarium, with two bulk sterilizers, a rack washer and a tunnel washer. There is also a centralized dock to receive animals and supplies, as well as a centralized storage for equipment and feed. This facility is also adjacent to the laboratory space of the CVID investigators. The facility will be secure and have (b)(4) (b)(4) will only be provided after IACUC approval of the animal activities and the personnel, and after facility training by the animal care staff. Limited access also supports the biosecurity of the animal holding, as does the directional air flow described below.

The bat room sizes will be based on the *Standardized Guidelines for Fruit and Nectar Bat Care* established by the Association of Zoos and Aquariums. Indiana flying foxes are one of the largest bat species with a wingspan up to 5 feet and require a significant amount of space. The Jamaican fruit bats and horseshoe bats are much smaller requiring less space (Table 1). The anteroom to each bat holding area will allow staff to safety enter and exit the bat rooms and minimize any bat escapes from the holding rooms. Personnel will don and doff the appropriate personal protective equipment which would include dedicated scrubs or lab coats, gloves, eye protection and respiratory protection. The respiratory protection within the holding rooms has a dual purpose in protecting personnel from allergens or any unknown agents and protecting the bats from human pathogens such as SARS-CoV2. A similar room entry procedure will be used for the ABSL2 areas based on the risk assessment for the agents in use.

Table 1. Association of Zoos and Aquariums space requirements for bats

Species	Weight	Wingspan	Enclosure* (b)(4)	Proposed space	Maximum capacity per room
Indian flying fox	1.6 kg	4-5 ft	(b)(4)	(b)(4)	21
Jamaican fruit bats	40-60 g	4-6 in			171
Horseshoe bats	30-40 g	3-5 in			212

*enclosure height is at least (b)(4) a- up to 6 bats, add 15% for each additional bat, b- up to 10 bats/(b)(4) for bats weighting up to 80 g. The density for the smaller bats is adjusted based on weight and wingspan such that Jamaican fruit bat density can be increased to 10 bats/(b)(4) SF and Horseshoe bats can be increased to 10 bats/(b)(4)

Architectural Description. The proposed Bat Resource Center will be designed and engineered in accordance with the codes in Table 2, the construction rating requirements in Table 3, and the building classification in Table 4.

The Bat Resource Center will be organized around the concept of (b)(4) (b)(4) intended to house various species including Jamaican fruit bats (*Artibeus jamaicensis),* Horseshoe bats (*Rhinolophus affinis*), and Pteropus bats (*Pteropus medius)*. The (b)(4) will provide access to larger holding rooms for the Pteropus bat colony and the (b)(4) will access a series of smaller holding and support rooms to provide flexibility and opportunities for specialized isolation, research and breeding of the smaller species. Each of the animal holding rooms will be (b)(4) that will serve as a procedure, preparation and gowning space. These (b)(4) will be dedicated for the larger holding rooms on the (b)(4) and will be shared for the smaller rooms on the (b)(4) Each (b)(4) will be equipped with a sink, counterspace, laboratory safety fixtures and some floor standing space for upright equipment and biosafety cabinets or procedure stations. The (b)(4) of the facility will house all support spaces and provide a (b)(4)

(b)(4) to connect the animal holdings corridors. These support spaces will include the office, break room for animal care staff and visiting researchers as well as unisex bathrooms, custodial space, a loading dock and the mechanical, electrical and telecommunications infrastructure spaces. A (b)(4) located food preparation and storage area will provide (b)(4) This kitchen will be equipped throughout with stainless steel casework, a dual basin sink and an (b)(4) (b)(4) built-in cold room with a recessed, insulated floor. All holding and procedure areas are designed around an (b)(4) modular concept for maximum flexibility with a minimum wall bench depth of (b)(4) where they occur and a minimum of (b)(4) clearance between bench faces or benches and floor standing equipment. The main corridors will maintain a width of (b)(4)

Table 2. Codes and Standards	
ICC International Building Code and reference standards	ICC International Fire Code
ICC International Plumbing Code	ICC International Mechanical Code
NFPA 70 National Electrical Code (NEC)	Americans with Disabilities Act Accessibility Guidelines (ADAAG) and American National Standards Institute (ANSI)
National Institutes of Health (NIH) Design Policy and Guidelines	NIH Design Requirements Manual
Association of Zoos and Aquariums	The Guide for the Care and Use of Laboratory Animals
CDC/NIH Biosafety in Microbiological and Biomedical Laboratories (BMBL) 6th Edition	Colorado State University Design and Construction Standards
National Fire Protection Association (NFPA) Standards	American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)	Underwriter's Laboratories, Inc. (UL)
National Electric Manufacturers Association (NEMA)	National Sanitation Foundation (NSF) Standards
American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbooks and Standards	National Electrical Safety Code (NESC)
Illuminating Engineering Society (IES) Lighting Handbook.	

Table 3. Construction Rating Requirements
Exterior Load Bearing Walls – 0 Hr. (IBC Table 601)
Exterior Non Load Bearing Walls – 0 Hr. (IBC Table 601)
Non Load Bearing Partitions – 0 Hr. (IBC Table 601)
Interior Load Bearing Walls and Columns – 0 Hr. (IBC Table 601)
Roof Construction – 0 Hr. (IBC Table 601)
Corridors – 0 HR. (IBC Table 1020.1)
Shafts – 1 HR. (IBC Section 707.4)

Table 4. Building Classification
Use Group B – Business (IBC Section 304)
Construction Type – Type II B (sprinkled)
Allowable Building Height – 55 feet (IBC Table 504.3)
Increase to 75 feet (sprinkled).
4 Stories allowed (IBC Table 504.4)
Allowable Area (b)(4) SF per floor (IBC Table 506.2)
Increase to (b)(4) SF per floor as allowed per IBC section 506 (S1)

Interior Construction. All construction systems will be specified to meet NIH guidelines which meet the criteria for both animal holding spaces and ABSL2 containment spaces. Partition wall construction will consist of minimum 20-gauge metal studs and 5/8" moisture resistant drywall throughout with a low-VOC epoxy paint finish in all corridors and support spaces and a fully sealed fiberglass reinforced panel system in all animal holding rooms. Ceilings will be drywall with epoxy paint in corridors and support spaces with the addition of the fully sealed FRP panels for the ceiling finish in the animal holding rooms. In addition, all animal holding rooms will be equipped with a ceiling mounted unistrut frame to support a fine stainless steel wire mesh system at 7'-0" above the floor in accordance with recommendations of the

American Zoological Association. This mesh will provide a substrate for the bats to hang and will be at a height that will permit handling and restraint. Flooring in the holding rooms will either be sealed concrete or a built-up rubberized surface to alleviate injury to the larger species housed within the facility. The rubberized floor is based on the recommendation of the those that routinely house larger bats, and will provide that additional level of safety for the bats and facilitate proper sanitation. Flooring in the corridors and support spaces will be sealed concrete. (See Table 1 Room Information List for all room finishes). The laboratory casework in the anterooms as well as the kitchen will be stainless steel with fully welded countertops with integral backsplashes and sinks.

Figure 2. Jamaican fruit bats roosting in shade cloth simulating 'tent' building.

Meeting species typical behaviors. Bat holding areas will be enriched to promote species typical behaviors. Areas for roosting will be provided to the bats. In our existing Jamaican fruit bat colony this is met by hanging a shade cloth from the ceiling with multiple folds in it for the bats to roost which simulates the tent building they perform in leaves in the wild (Figure 2). Roosting areas are also provided in the ceiling by inverting a wire mesh box. The shade cloths and roosting boxes are easily removed and sanitized in the cagewash facility. Feeding stations are placed throughout the holding room, and the fruit can be hung from various locations which facilitates flight. A similar housing situation can be used to maintain the Horseshoe bats by providing roosting areas with shade cloth and inverted mesh boxes, and locating insect feeding stations throughout the room. The Pteropus bats require additional materials to facilitate roosting. In addition to the wire mesh ceiling that they can hang from, additional materials can be introduced to provide variable hanging locations through the room. These include artificial tree branches, ropes and other materials that can be distributed throughout the room at various heights to accommodate their hierarchical structure, which can be easily replaced when soiled. Multiple feeding stations throughout the room and in the center of the room facilitate flight. There is a column located in the middle of each of the Pteropus rooms which can be used as a feeding station. The Pteropus are then encouraged to fly in a circular pattern during feeding times. The funding for these materials is not a component of this proposal and will be part of the initial operating costs (Institutional Letter of Support), and we will work with our partners from the Lubee Bat Conservancy and the USGS to provide the appropriate environment for the bats (See Letter of Support).

Exterior Construction. New exterior construction will consist of a unit masonry wainscot with a metal panel veneer above on a continuously insulated structural stud frame with a spray applied vapor barrier. The structure will consist of concrete spread and strip footings, a reinforced concrete floor slab and structural steel frame above. The roof structure will be comprised of steel beams with shallow open web steel joists spanning between to support corrugated roof deck, insulation, protection board and an 80 mil, fully adhered EPDM roofing system that is sloped at ¼" per foot minimum to drain.

Net and Gross Square Feet of Proposed Layout. The total new square footage provided under this proposal is (b)(4) gross square feet. Excluding corridors, restrooms and mechanical / electrical support spaces, the net new usable square footage created within the facility is (b)(4) net square feet, yielding a corresponding net to gross ratio of 69.8%. Table 1 (Room Information List) provides a summary of the requested space with the individual room physical dimensions, net square footage, and the wall, floor and ceiling finishes.

Green/Sustainable Design. In the development of the design for this project all viable options will be evaluated to maximize the opportunities for sustainable design. Some key areas of focus will include:

- Utilize a third-party commissioning agent to review systems design and systems implementation.
- Design to minimize water usage within the facility.
- Design of mechanical and electrical systems to minimize energy usage.
- Selection of materials high in post-consumer recycled content.
- Use of paints, coatings, sealants and adhesives that have recommended low levels of volatile organic compounds.
- Where possible incorporate the use of natural daylight within human occupied spaces.
- Provide user controllability for lighting systems while still meeting specified requirements.
- Develop the construction schedule to allow for building flush out to minimize the chance of off-gassing within the building.

Mechanical Systems. Two new 100% outside air handling units (AHUs) will be provided to serve the facility. Each AHU will be sized to handle the entire load (100% redundancy) plus 20% additional capacity to handle future growth. The supply air ductwork downstream of the AHUs will be connected. The new AHUs will be located on the roof and will include service corridors for maintenance access. The AHUs will operate in a variable volume (VAV) mode.

The components of each new AHU will be as follows (listed in direction of airflow):

Component	Comments
Outside air dampers	Low-leak dampers
Prefilter bank	MERV 8, 2" plated filters
Final filter bank	MERV 14, 12" cartridge filters
Heat recovery coil bank	Runaround water coil, glycol for freeze protection
Preheat coil bank	Heating water coil, pumped for freeze protection
Steam humidifier	High-efficiency dispersion grid
Cooling coil bank	Chilled water coil
Supply fan(s)	Fan array controlled by VFDs
Sound attenuator	Sound attenuator bank
Discharge dampers	Low-leak dampers

Exhaust Systems. Two new centrifugal exhaust fans, sized for N+1 redundancy, will be provided on the roof on the heat recovery unit. The exhaust fans will use VFDs to maintain proper airflow and be controlled to maintain a system static pressure setpoint. Exhaust discharge from the building will be located as far as feasible from fresh air intakes and from other buildings to help prevent air recirculation into the building.

Heat Recovery System. A new glycol runaround loop heat recovery systems will be provided to transfer heat between the exhaust air and outside air streams. All heat recovery system components will be located in a new rooftop heat recovery unit consisting of MERV 8 filters, heat recovery coils, access space, and a service corridor to house a heat recovery pump, glycol feeders, and associated hydronic specialties.

Supply and Exhaust Air Distribution Systems. A variable volume (VAV) air distribution system will be utilized to maintain proper pressurization of spaces and temperature control. Each control zone will be served by a supply air valve with an integral reheat coil. The air valve will provide required airflow to maintain the room setpoint temperature while simultaneously maintaining proper pressurization relationships. As a general rule, the (b)(4)

(b)(4)

(b)(4)

The exhaust system will operate in a VAV mode similar to the supply air system. Each control zone will be served by a corresponding exhaust air valve. The airflow of the exhaust air valve will "track" the airflow of the corresponding supply air valve to guarantee proper space pressurization is maintained.

Humidification. A new rooftop steam-to-steam humidifier will be provided to humidify the AHU supply airstream. Additional zone-level steam humidifiers will be provided to meet the higher humidity levels required in the animal holding areas.

Chilled Water System. New direct-buried chilled water will be extended to the new facility from the existing campus loop system north of the building. New chilled water pumps (N+1 redundancy), buffer tank, and accessories will be provided in the first-floor mechanical room to distribute chilled water to the new AHUs. VFDs will be provided to modulate pump speed as necessary to satisfy loads.

Steam and Condensate System. New steam and condensate piping will be extended to the new facility from the existing campus system. A new vault will be constructed, and new lines will be extended to the first-floor mechanical room, where a pressure-reducing station will be installed. Low pressure steam will be routed to the heat exchangers and humidifiers. A new condensate pump will return condensate back to the campus loop.

Heating Water System. New shell-and-tube heat exchangers, new heating water pumps, all sized for N+1 redundancy, will be installed in the new first floor mechanical room. The heat exchangers and pumps will be used to generate and distribute heating water throughout the facility. VFDs will be provided for each pump to allow for pump speed modulation to satisfy building loads.

Building Automation System. A building automation system (BAS) will provided for the new facility. All components will be provided in accordance with University standards to ensure proper control and monitoring, and compatible with the existing BAS used for other vivaria on campus. The BAS will have the capability to adjust setpoints and system operation to match changing facility functions. Control points tied into the BAS will include local and remote alarming. Animal holding rooms will be provided with room monitor displays to track temperature, humidity, and pressurization levels.

Temperature and Humidity Parameters. Table 5 provides the temperature, ventilation, and noise parameters that will be used as the basis for the design of the building HVAC systems.

Table 5. Temperature and Humidity Parameters.
DBT- dry bulb temperature; WBT- wet bulb temperature; ACH- air changes per hour; RH- relative humidity

Outdoor Design Conditions					
Winter DBT (^{O}F)	2.8				
Summer DBT (^{O}F)	95				
Summer Coincident WBT (^{O}F)	78				
Indoor Design Conditions					
	ACH	DBT (^{O}F)	RH (%)	DBT (^{O}F)	RH (%)
		Winter		Summer	
Animal holding areas	15	77	40-50	77	50-60
Animal support areas	12	72	25-35	75	50-60
Office/general areas	6	72	25-35	75	50-60
All other areas	6	72	25-35	75	50-60

Many of the bat species proposed for this facility are tropical bats requiring higher temperatures and ambient humidity levels compared to more traditional laboratory animals. As such the setpoint temperature for the bat rooms will be 77°F with a relative humidity at 50%. These will be adjusted based on the species needs.

Plumbing Systems. New water and sanitary sewer services will be provided for the facility, with each connecting to the nearby existing campus mains. New steam-fired water heaters (N+1 redundancy) will be provided to generate hot water. Domestic cold and hot water will be extended to all potable water use points. Non-potable water will be created via reduced-pressure backflow preventers to serve all animal and laboratory needs. Hose bibbs and floor drains with a minimum 4" drain will be provided for washdown in each animal holding room. A new reverse osmosis system will be provided to serve humidifier feedwater requirements. Sanitary waste and vent piping will be extended to all required fixtures and drains. Storm drains will be discharged to grade and drained to the existing detention pond adjacent to the facility.
Fire Protection. A new wet-pipe sprinkler system will be installed to provide full coverage for the facility. All work will comply with NFPA 13 and other local requirements.

Electrical Systems. The electrical design for this project will include the following:

- New 480Y/277V, 3 Phase, 4-Wire normal electrical service to the facility.
- Generator back up for code required life safety loads, in addition to critical standby loads, including mechanical equipment to maintain the integrity of the bat housing environments throughout the facility.
- LED lighting systems and associated controls throughout the facility.
- Receptacle layouts to support computer equipment, laboratory equipment and special and general-purpose needs the facility.
- Outlet boxes, raceway distribution systems, and installation of telecommunications cabling, provided by Colorado State University Telecom.
- Necessary redundant electrical feeds to critical HVAC equipment.
- A new addressable fire alarm system.
- Electrical rough-in and connections to support the installation of (b)(4) low voltage environmental monitoring systems associated with the vivarium, and other critical equipment.

Additionally, the electrical design will include, but will not be limited to the following containment practices:

- Access to the facility addition will be restricted to authorized personnel (b)(4) (b)(4)
- A (b)(4)
- Access to containment areas will be controlled (b)(4) Similarly, door between the bat holding areas and (b)(4) will be interlocked to prevent inadvertent escapes. This also meets the requirement for Pteropus species to have a double door enclosure.
- All electrical penetrations into containment areas will be adequately sealed to ensure containment within the space, and waterproof to allow for decontamination. Seals will be included around conduit penetrations and around cabling within raceway systems.
- Light fixtures in containment and bat holding areas will be triple sealed, gasketed, and a minimum of IP65 listed. Fixture lenses will be installed with the smooth surface out to provide an easily cleanable surface.
- The emergency generator system will serve all life safety loads (e.g. egress lighting, animal room lighting, fire alarm system), as well as supply and exhaust systems, pumps to support building heating and cooling systems, HVAC controls, devices in animal holding rooms, refrigerators and freezers in laboratory areas, and any other critical loads as required per the facility users/director.

Electrical Distribution System. The Colorado State University campus electrical utility system/plant is arranged for reliability and redundancy. The main power to IDRC complex is buried underground which minimizes power outages due to weather and fowl. A new diesel driven generator and its associated distribution system will be utilized to serve all new emergency/standby electrical distribution equipment. Both the generator and the normal power electrical service have more than adequate capacity to serve the facility while maintaining future flexibility.

New normal power and emergency/standby power 480Y/277-volt, 3 phase, 4 wire and 208Y/120-volt, 3 phase, 4 wire distribution panels, branch panelboards and dry-type transformers will be added under this project's scope. The new equipment will be located in dedicated electrical rooms. Separate panelboards will be provided for containment and non-containment areas. In general, HVAC equipment and large equipment loads will be served at 480 volts, 3-phase. Lighting throughout the facility will be served at 277 volts, single phase. Animal holding, laboratory, office, computer equipment, and general-purpose receptacle circuits will be served at 120 volts, single phase. All other equipment and devices will be served by the appropriate distribution system voltage.

Distribution panels and branch panelboards will make use of circuit breakers for overcurrent protection and will be fully rated to accommodate short circuit characteristics within the existing facility. Copper bussing will be provided for all electrical distribution system equipment. The electrical distribution system for the addition will allow for the following:

- System capacity to accommodate present and future loads
- Efficient service to building lighting, equipment and HVAC loads.

Electrical Service to HVAC Equipment. Normal and emergency electrical service to HVAC equipment will be provided as required to maintain life safety of humans and bats. All necessary starters, disconnect switches, control devices and VFD connections will be provided to ensure a complete and functional system installation.

Receptacle Layouts. Receptacle layouts and circuiting to animal holding rooms, laboratory equipment, office equipment, special purpose and general-purpose needs will be provided in accordance with direction from facility personnel. All electrical devices will be labeled with the panel source and circuit number. Dedicated receptacles will be provided as required to support specific equipment locations. All receptacle branch circuits will be provided with equipment ground conductors and dedicated neutral conductors. All branch circuit wiring will be copper and will be installed in concealed raceway systems. In animal holding areas, weatherproof, ground fault interrupting receptacles will be provided to support necessary equipment functions. Ground fault interrupting type receptacles will be provided in all other Code required locations, and in all designated "wet" locations throughout the facility.

Lighting. Lighting systems throughout the facility will be designed in accordance with NIH policies and guidelines, Colorado State University design guidelines, IESNA recommendations, and direction provided by the National Research Council's (NRC) *Guide for the Care and Use of Laboratory Animals*. Lighting power densities will be minimized by using highly efficient, LED fixtures throughout the facility. The LED lighting with balanced spectral energy, and high color rending indexes will be used in the holding rooms. Lighting control will utilize line voltage type toggle switches in non-animal holding rooms. Occupancy/vacancy sensors will be used throughout most non-animal holding spaces to provide automatic off of lighting loads during unoccupied times. In all animal holding rooms, time-based lighting controls coupled with momentary contact override switches will be utilized in order to maintain the animals' diurnal cycles, while allowing for maintenance override when necessary. This lighting system will in holding rooms will slowly dim on and off to simulate dawn and dusk conditions for the bats. These time frames are when they are typically most active, and the crepuscular cycle will enhance their environment.

Telecommunications. All telecommunications device rough-in, including outlet boxes and raceway distribution, will be provided as necessary to support the installation of Colorado State University installed,

and provided cabling. Telecommunication outlet locations will be directed by facility personnel, but will include at minimum the office spaces and anterooms throughout the facility.

Security Systems. (b)(4)

(b)(4)

Equipment Monitoring System. The cold room will be equipped with monitoring systems that notify appropriate personnel upon failure.

Fire Alarm System. A new addressable fire alarm system will be provided for the facility. The system will be designed in accordance with all current Codes and standards and will also satisfy all current accessibility guidelines. Careful attention will be necessary when selecting the fire alarm annunciation strategy in and around the animal holding rooms. Certain animals can be greatly affected by the tones and visual effects from these fire alarm devices, particularly bats capable of hearing ultrasounds. Further details will be coordinated with the owner.

Fixed Equipment. There fixed equipment is highlighted in Table 2 at the end of the proposal. This includes 4 class II type A2 biological safety cabinets for the anterooms. These will be used for handing and manipulation of the smaller bats, particularly when they are used for studies in the ABSL2. This will provide protection to both personnel and the bats during the manipulations. The cold room is necessary to store fruit for the bats. Our current colony of Jamaican fruit bats consumes approximately 750 pounds of fruit each week, and the larger Pteropus bats will require approximately 450 pounds of fruit each week for 30 bats. This will require weekly deliveries from the supplier and proper storage is critical to prevent the fruit from spoiling and to maintain its quality.

Technical Challenges. Given this is new construction on a site which has just completed the construction of CVID, we do not anticipate any technical challenges. The CSU Facilities Maintenance personnel are very familiar with the site and locations of the critical infrastructure and it is easily accessible.

Conclusion. The Bat Resource Center for the Study of Zoonotic Disease is an important resource needed in to address the significant impacts bats have as reservoirs of human diseases. Enabling investigators to study these pathogens in a controlled environment is critical to our understanding of disease transmission to humans and will greatly enhance our abilities to respond to outbreaks such as the COVID-19 pandemic. Colorado State University and the CVID has exceptional expertise in rearing and using bat models and we are well positioned to maintain the Bat Resource Center to serve as a national and international resource.

Line Drawings

ROOM NAME	ROOM NO.	RENOVATION (R) / NEW CONSTR. (NC)	DIMENSION INFORMATION				PROPOSED FINISH INFORMATION		
			ROOM WIDTH	ROOM DEPTH	ROOM SF	NET USABLE SF	FLOOR	WALL	CEILING
FIRST FLOOR									
Mechanical	(b)(4)	NC	(b)(4)				CONC	GPDW-PT	OPEN
Water Service		NC					CONC	GPDW-PT	OPEN
MDF		NC					CONC	GPDW-PT	OPEN
Electrical		NC					CONC	GPDW-PT	OPEN
Electrical		NC					CONC	GPDW-PT	OPEN
Receiving		NC					CONC	GPDW-PT	OPEN
ABSL-2 Bat Holding		NC					CONC	FRP	GPDW/SSM
Isolation		NC					CONC	FRP	GPDW/SSM
Ante Room/ Procedure		NC					CONC	GPDW-EPX	GPDW - EPX
ABSL-2 Bat Holding		NC					CONC	FRP	GPDW/SSM
Bat Holding		NC					CONC	FRP	GPDW/SSM
Isolation		NC					CONC	FRP	GPDW/SSM
Ante Room/ Procedure		NC					CONC	GPDW-EPX	GPDW - EPX
Bat Holding		NC					CONC	FRP	GPDW/SSM
Jamaican Fruit Bat Holding		NC					CONC	FRP	GPDW/SSM
Ante Room/ Procedure		NC					CONC	GPDW-EPX	GPDW - EPX
Isolation		NC					CONC	FRP	GPDW/SSM
Jamaican Fruit Bat Holding		NC					CONC	FRP	GPDW/SSM
Horseshoe Bat Holding		NC					CONC	FRP	GPDW/SSM
Ante Room/ Procedure		NC					CONC	GPDW-EPX	GPDW - EPX
Insect Rearing		NC					CONC	FRP	GPDW/SSM
Medical Treatment Room		NC					CONC	FRP	GPDW/SSM
Cold Room		NC					ALUM	ALUM	ALUM
Kitchen		NC					CONC	GPDW-EPX	GPDW-EPX
Restroom		NC					RFT	GPDW-PT	GPDW-PT
Restroom		NC					RFT	GPDW-PT	GPDW-PT
Custodial		NC					CONC	GPDW-PT	OPEN
Office/ Break Area		NC					RFT	GPDW-PT	ACT
Pteropus Male Holding		NC					SRF	FRP	GPDW/SSM
Ante Room/ Procedure		NC					SRF	FRP	GPDW/SSM
Ante Room/ Procedure		NC					CONC	GPDW-EPX	GPDW - EPX
Pteropus Maternity/ Growing		NC					SRF	FRP	GPDW/SSM
Ante Room/ Procedure		NC					SRF	FRP	GPDW/SSM
Pteropus Breeding		NC					SRF	FRP	GPDW/SSM
Corridor		NC					CONC	GPDW-EPX	GPDW - EPX
Corridor		NC					CONC	GPDW-EPX	GPDW - EPX
Corridor		NC					CONC	GPDW-EPX	GPDW - EPX
Vestibule		NC					CONC	GPDW-PT	GPDW - PT

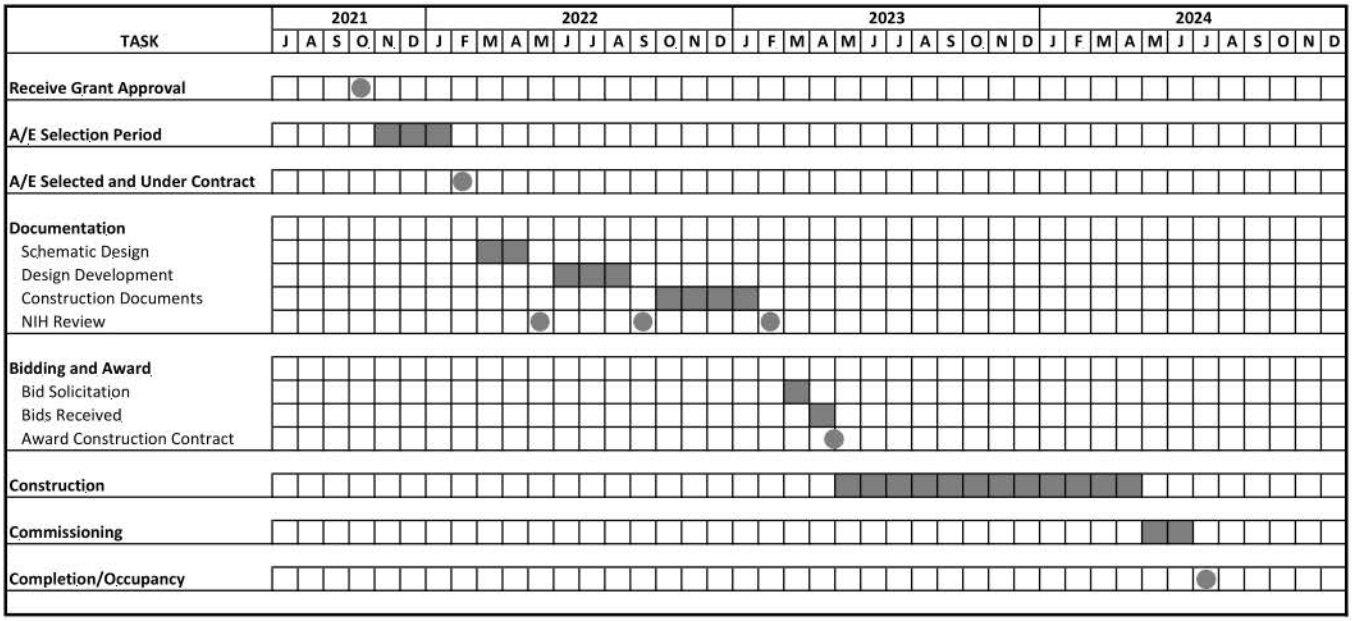
FINISHES KEY	
Acoustic Ceiling Tile	ACT
Stainless Steel Suspended Mesh	SSM
Open to Structure	OPEN
Concrete	CONC
Seamless Rubber Flooring (24mm thickness)	SRF
Epoxy Resin Flooring	EPXF
Resilient Floor Tile	RFT
Epoxy Paint	EPX
Fiber-Reinforced Wall Panel	FRP
Painted Gypsum Drywall	GPDW-PT
Tiled Gypsum Drywall	GPDW-T
Insulated Aluminum Panel (cold room)	ALUM

TABLE 1: ROOOM INFORMATION LIST

KEY #	EQUIPMENT	MANUFACTURER	SIZE	TOTAL COST	LOCATION (ROOM NO.)
1	Class II A2 Biosafety Cabinet	Labconco	(b)(4)	$22,072	(b)(4)
	Class II A2 Biosafety Cabinet	Labconco		$22,072	
	Class II A2 Biosafety Cabinet	Labconco		$22,072	
	Class II A2 Biosafety Cabinet	Labconco		$22,072	
2	Cold Room	Labworks		$144,708	

TABLE 2: EQUIPMENT LIST

Funding Agency	Grant Number	Title	PD/PI	Annual Direct Costs FY2020	Start and End Dates
DOD	G228-19-W7329	Preventing emergence and spillover of bat pathogens in high-risk global hotspots	R. Plowright	$2,000,000	10/01/2021-04/30/2023
DOE-NNSA-Lawrence Livermore National Laboratory	B634747	Vaccination of the fly: the use of mosquitoes to vaccinate bat populations that harbor human pathogens	R. Kading	$225,000	05/28/2019-03/30/2022
NIH/NIAID	R01 AI40442	Middle East respiratory syndrome coronavirus (MERS-CoV) and SARS-coV-2	S. Weiss	$294,000	07/01/2018-06/30/2023
NIH/NIAID	R01 AI34768	Investigating a novel HL18NL11 bat influenza A virus	W. Ma	$240,000	01/01/2018-12/31/2023
NSF/EAGER	2033260	Immune response of Jamaican fruit bats experimentally infected with sARS-CoV-2	T. Schountz	$128,000	06/01/2020-05/31/2022
(b)(4)					



PROJECTED TIMELINE

Budget Justification

The budget justification form provides a line item explanation of the key components of the $7.99M budget for the construction of the Bat Resource Center for the Study of Zoonotic Diseases. The construction costs is $6.3M which equate to (b)(4) SF. This seems to be inline with the construction of our current facility on campus which is an equivalent size. While the contingency is slightly slower that the typical 10%, given that this is new construction in a location CSU has already expanded on, there should be fewer issues that arise, particularly as it relates to connecting to the current utilities.

The budget also includes $232,996 for equipment costs. This is for 4 class II type A2 biological safety cabinets to be placed in the anterooms to the small bat holding rooms and the ABSL2 suite. These will be used to handle and restrain bats during sample administration and collection and provides protection to both personnel and the bats. The cold room is necessary to store the fruit for bat feeding. We anticipate over 1000 pounds of fruit to be used each week to feed the bats and adequate cold storage is need to store the fruit to prevent it from spoiling. We anticipate that we will require weekly deliveries of fruit, however, the cold room will also provide use storage capacity for fruit in the event of an emergency.

Budget Justification Form

Details of the costs summarized in SF 424C are provided below:

		Unit Costs	Totals
1.	**Administrative and Legal Expense**		
	• Advertising, Reproduction and Archiving	$ 22,500	
		Subtotal	**$ 22,500**
2.	**Land, Structures, Rights of Way, Appraisals, Etc.**		
	• Land, Structures, Rights of Way, Appraisals, NEPA	$ 22,500	
		Subtotal	**$ 22,500**
3.	**Relocation Expenses and Payments**		
	• Relocations and Moving Costs	$ 30,000	
		Subtotal	**$ 30,000**
4.	**Architectural and Engineering Fees**		
	• Basic Services and Additional Services	$ 541,753	
	• Grant Preparation	$ 20,000	
	• Commissioning	$ 90,292	
	• Reimbursables	$ 10,000	
		Subtotal	**$ 662,045**
5.	**Other Architectural and Engineering Fees**		
	(All Fees Indicated Above in Item 4.)	*Subtotal*	**$0**
6.	**Project Inspection Fees**		
	• Campus Project Management and Inspection	$ 310,000	
		Subtotal	**$ 310,000**
7.	**Site Work**		
	(Included in Construction Costs Below in Item 9.)	*Subtotal*	**$0**
8.	**Demolition and Removal**		
	(Included in Construction Costs Below in Item 9.)	*Subtotal*	**$0**
9.	**Construction**		
	Contractor Items		
	• General Conditions	$ 368,300	
	• Demolition	$ -	
	• Foundations and Substructure	$ 189,200	
	• Superstructure	$ 464,724	
	• Exterior Closure	$ 381,420	
	• Roofing	$ 252,150	
	• Interior Construction	$ 845,750	
	• Conveying	$ -	
	• Casework	$ 43,550	
	• Specialties	$ 176,016	
	• Site Work	$ 172,120	
	• Mechanical	$ 2,065,110	
	• Electrical	$ 610,740	
	• Contractor Overhead and Profit	$ 450,400	
		$ 6,019,480	
	Owner Items		
	• HVAC Testing & Controls	$ 53,547	
	• Materials Testing	$ 26,774	
	• Utility Infrastructure	$ 75,000	
	• (b)(4) Signs, Fire Extinguishers, Telecom	$ 126,988	
		$ 282,309	
		Subtotal	**$ 6,301,789**
10.	**Equipment**		
	• Equipment Total Per Vendor Quote	$ 232,996	
		Subtotal	**$ 232,996**
11.	**Miscellaneous**		
	• Start up Costs	$ 36,600	
	• Computerized Controls		
		Subtotal	**$ 36,600**
12.	**SUBTOTAL (Items 1 thru 11)**		**$ 7,618,430**
13.	**Contingencies (Items 1 thru 11)**		**$ 380,920**
14.	**SUBTOTAL (Items 12 and 13)**		**$ 7,999,350**
15.	**Project (Program) Income**		**$0**
16.	**TOTAL PROJECT COSTS (subtract # 15 from #14)**		**$ 7,999,350**

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Withheld pursuant to exemption

(b)(4)

of the Freedom of Information and Privacy Act

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Withheld pursuant to exemption

(b)(4)

of the Freedom of Information and Privacy Act

Page 61 of 94

Withheld pursuant to exemption

(b)(4)

of the Freedom of Information and Privacy Act

(b)(6)

March 12, 2021

Gregor Ebel, PhD
Director, Center for Vector-borne Infectious Diseases
Colorado State University

Re: Letter of Support for C06 proposal

Dear Greg,

I enthusiastically support your NIH C06 grant proposal, *Establishment of the Bat Resource Center for the Study of Zoonotic Diseases*, to construct an animal facility for the breeding and rearing of bat species including Indian flying foxes, horseshoe bats, and Jamaican fruit bats. These species have been identified as important reservoir hosts for zoonotic diseases such as Nipah virus and SARS-related coronaviruses. The facility will enable CSU to be a critical national resource for investigators that are working to understand how they host these viruses without disease, and to determine how virus shedding and spillover might occur.

Should the grant be awarded, my office will provide the funds necessary to complete the construction, if needed, and provide funds for the initial operations of the Bat Resource Center. Once completed, the Bat Resource Center will have climate-controlled, free-flight space for maintaining the breeding colonies, plus procedure space, food preparation and storage, and veterinary space. Given our successful history of maintaining Jamaican fruit bats, and our collaborations across the country, we are well poised to be the host site for this important national resource.

Good luck on the proposal.

Sincerely,

(b)(6)

CSU SYSTEM
COLORADO STATE UNIVERSITY
FORT COLLINS | PUEBLO | GLOBAL

March 12, 2021

Department of Health and Human Services
National Institutes of Health
Division of Program Coordination, Planning and Strategic Initiatives, Office of Research Infrastructure Programs
Funding Opportunity Title: Biomedical Research Facilities
Activity Code: Research Facilities Construction Grant
Funding Opportunity Announcement Number: PAR-21-139

To Whom It May Concern:

This opinion is being rendered to you by the undersigned as General Counsel to the Board of Governors of the Colorado State University System, for the benefit of Colorado State University ("CSU") in connection with its proposal in response to the above-referenced Funding Opportunity. As part of the proposal, CSU has been asked to provide a Certification of Title to Site, specifically:

> *Applicants must include a legal opinion describing the interest the applicant institution has in the performance site. The legal opinion should describe any mortgages or other foreclosable liens on the property, including the principal amount of the mortgage (and rate of interest); the dates of the mortgage; the terms and conditions of repayment; the appraised value of the property; and any provisions designed to protect the Federal interest in the property. The facility must be utilized for biomedical research purposes for which it was approved for at least 20 years beginning on the date of beneficial occupancy of the space. Any lease agreement must cover a time period sufficient for the usage requirement and be a minimum of 20 years in length from the completion of the facility.*

Please be advised that the Board of Governors is a constitutionally established body corporate under Article VIII, Section 5 of the Constitution of the State of Colorado and has additional authority under Colorado Revised Statutes. As stated in C.R.S. § 23-31-102, the Board of Governors of the Colorado State University System is a body corporate, capable in law of taking, holding, acquiring, exchanging, selling, and determining the uses of personal property and real estate, or any interest therein, and the ownership of such property is "vested in the board of governors of the Colorado state university system or the entities governed by it …." In

addition, C.R.S. § 23-31-103 grants CSU's Board of Governors the authority to determine how the Board and Colorado State University uses its land. This statute provides that CSU's Board of Governors "has the general control and supervision of the Colorado state university and lands and the use thereof …."

In accordance with Colorado law, the Board of Governors is the legal owner of the land that would serve as the location for the Proposed Bat Research Facility, which is identified in the attached document (the "Site"). CSU owns the land for the Site free of any mortgages or foreclosable liens. Accordingly, the proposed Site would properly serve as a location for biomedical research purposes, specifically as a Bat Research Facility, for at least twenty (20) years.

The Site is within a larger parcel known as the Andrews Tract, CSU Parcel 110, Larimer parcel ID 9717000907. The Site is located within Larimer County, in the State of Colorado. The size of the Site for the Proposed Bat Facility is approximately (b)(4) feet by (b)(4) feet, or (b)(4) square feet. The undersigned is not a licensed appraiser and has not performed an appraisal of the value of the Site. However, for the purposes of Colorado State University's proposal, we have estimated the actual land value for the Site to be approximately (b)(4) per acre. Given that the Site is (b)(4) of an acre, the estimaged land value of the Site is approximately $8,802.

Please understand that this estimation is only provided for the limited purpose of the University's proposal and should not be relied upon as an appraisal of the Site. If such an appraisal is needed, NIH should obtain an independent appraisal from a licensed appraiser. In addition, please understand that this legal opinion should not be construed as or relied upon as legal advisc to NIH or any other third party. Furthermore, I am basing the opinions set forth in this letter on my personal knowledge and I am not aware of any facts that have come to my attention that would give me actual knowledge or actual notice that my opinions or statements are not accurate or complete. Except as otherwise stated in this opinion, I have undertaken no investigation or verification of such matters.

I am qualified to practice law in the State of Colorado, and I do not purport to be an expert on, or to express any opinion concerning, any law other than the law of the State of Colorado. I am not a licensed appraiser and do not purport to give an appraisal of the Site. Please be advised that this opinion letter is issued as of the date hereof and that events and developments subsequent hereto (including changes in present law or the interpretations of such laws) could cause the foregoing opinions, if given then, to be changed or withdrawn. These opinions are furnished solely for the benefit of the addressees stated above and for the proposal submitted by Colorado State University. This opinion letter may not be used or relied upon by any other party or delivered to any other party.

Very truly yours,

(b)(6)

Colorado State University

(b)(6)

March 12, 2021

Gregory Ebel, PhD
Director, Center for Vector-borne Infectious Diseases
Colorado State University

Re: Letter of Support for C06 proposal

Dear Greg,

We are pleased to support your NIH C06 grant proposal, *Establishment of the Bat Resource Center for the Study of Zoonotic Diseases*. Faculty within the College of Veterinary Medicine and Biomedical Science, Department of Microbiology, Immunology and Pathology, have a long and successful history of studying infectious diseases and zoonotic diseases. One of our most successful programs is the The Center for Vector-borne Disease (CVID, formerly known as the Arthropod-Borne Infectious Disease Laboratory), is an internationally recognized program for their study of insect vectors and their interaction with the host, the environment and people. Bats are becoming an increasingly important reservoir for emerging viral infections in humans, yet the ability to study them in a controlled environment is lacking. The facility in this proposal will address those unmet needs. This facility will enhance our research programs and national collaborations by expanding our abilities to study bats as a vector. We are committed to continue to our leadership and collaboration in the field of vector-borne diseases.

Sincerely,

(b)(6)

(b)(6)

(b)(6)

(b)(6)

March 5, 2020

Gregory Ebel, PhD
Director, Center for Vector-borne Infectious Diseases
Colorado State University
Fort Collins, CO 80523

Dear Dr. Ebel,

It is my pleasure providing you with a letter of support for you NIH C06 grant proposal, "*Bat Resource Center for the Study of Zoonotic Diseases*." As you are aware, bats are important reservoir hosts of many zoonotic diseases that cause significant human suffering and economic impacts. Even now, two bat-borne disease outbreaks are ongoing; the COVID-19 pandemic and the recent outbreak of Ebola virus disease in Guinea and the Democratic Republic of the Congo. Other important diseases are caused by bat-borne viruses, include Nipah virus encephalitis, Middle East respiratory syndrome, and Marburg virus disease. As a nation, we are poorly equipped to understand how these viruses circulate in their bat hosts and spill over into human populations. The ability to conduct basic research, including experimental studies of viruses in their natural bat hosts would significantly improve our ability to address important questions such as transmission, pathogenesis, and viral tolerance. One of the major impediments to conducting these studies is the lack of bat lab animal models. Most of the significant emerging zoonotic viruses are carried by Old World bat species (e.g. Africa & Asia) that do not occur in North America, making it necessary to establish breeding colonies here that can provide the most important species for scientific research. A major impediment to establishing sustainable colonies of bat models is the lack of suitable free-flight facilities for housing breeding colonies for bats, which require larger spaces than conventional laboratory animal species. Thus, the construction of a facility to house multiple bat species for use by investigators in the United States is required before meaningful research can be performed to understand the relationships of these viruses to their natural hosts, and what factors contribute to spillover events that occur annually. With this knowledge, it likely will be easier to design mitigation strategies to minimize the risk of spillover events in the future.

This proposed effort is of direct relevance to and highly synergistic with our pending R24 proposal to establish specific bat colonies at CSU. I have more than 20 years of experience studying zoonotic viruses in their bat reservoirs *in situ*, having worked with dozens of species and thousands of bats, including the Indian flying fox, the natural reservoir for Nipah virus in Asia and horseshoe bats that are the likely reservoir hosts of the viruses that have caused SARS and COVID-19. I am among the many US-based scientists who would greatly support and utilize bat animal models to better understand immunology and infection. For that reason, I enthusiastic support this effort, and if I can provide any assistance to you, I would be most willing to do so.

Sincerely,

(b)(6)

(b)(6)

National Institute of Allergy and Infectious Diseases

ROCKY MOUNTAIN LABORATORIES

Division of Intramural Research
National Institute of Allergy
and Infectious Diseases
Laboratory of Virology
Virus Ecology Section

March 5, 2020

Gregory Ebel, PhD
Director, Center for Vector-borne Infectious Diseases
Colorado State University
Fort Collins, CO 80523

Dear Dr. Ebel,

It is with utmost pleasure to provide a letter of support for your proposed C06 grant to construct the Colorado State University bat vivarium. Outbreaks of bat-borne zoonotic viruses such as coronaviruses, henipaviruses and filoviruses, have had an enormous impact on human health. The unpredictability of the zoonotic introductions of these bat-borne viruses limits the potential for effective intervention strategies. Within our research at the NIAID's Rocky Mountain Laboratories, we have directly focussed on bat-borne viruses such as Nipah virus, Ebola virus, MERS-CoV and now SARS-CoV-2, the cause of COVID-19. In particular we have extensive knowledge of bat infection models of ß-coronaviruses (MERS-CoV and WIV-1, in *Artibeus* and *Rousettus* bats) and Nipah virus (*Rousettus* bats) and are one of the few facilities which are completely set-up to perform bat studies in high and maximum containment (including long-term husbandry and on-site veterinary staff) and complete downstream immunological, genetic and virological analyses. The addition of facilities for bat breeding colonies, for which demand is significantly increasing, is essential for understanding the risk of spillover of bat viruses to humans.

We are highly enthusiastic to support construction of a vivarium for the breeding of key bat species at CSU. Having access to natural hosts for coronaviruses, henipaviruses and filoviruses will significantly advance research in infectious disease undertaken by our groups and others at RML and the research community as a whole, and we are committed to working with Co-I Dr. Schountz at CSU (long standing research collaborations on zoonotic viruses) to develop and use the resources generated through this C06 proposal. The SARS-CoV-2 pandemic marks an occasion which should put renewed focus on detailed studies of bats as reservoirs of emerging diseases. After SARS-CoV-1, MERS-CoV and Ebola virus in West Africa, we have yet another high impact (both from public health as economic perspective) bat-borne disease which justifies the urgent need for facilities in the US for advanced bat infectious disease studies.

Please feel free to contact us with any questions,

Sincerely,

(b)(6)

Heinz Feldmann, M.D.
Chief, Laboratory of Virology
Chief Scientist of the RML BSL4 Laboratories

(b)(6)

Vincent Munster, Ph.D.
Chief, Virus Ecology Section
Laboratory of Virology

903 S. 4th St., Hamilton, MT 59840
Phone: 406-375-7489
Fax: 406-375-9620
Email: munstervj@niaid.nih.gov

(b)(6)

March 12, 2021

TO:
Gregory Ebel, PhD
Director, Center for Vector-borne Infectious Diseases
Colorado State University
Fort Collins, CO 80523

RE: Letter of Support for C06 Bat Facilities Expansion Grant

Dear Dr. Ebel,

We pleased to offer our enthusiastic support for your C06 application to secure funding to construct a bat vivarium. As you know, bats are important reservoir hosts for a number of human pathogenic viruses that have caused many outbreaks, including the current COVID-19 pandemic. Our laboratories study diseases caused by several bat-borne viruses, including SARS-CoV-2, Ebola virus and Nipah virus, that of high priority to the National Institutes of Health and the World Health Organization. A critical obstacle to understanding how these viruses persist in nature and what mechanisms lead to their spillover into human populations is the lack of relevant species of bats that serve as reservoir hosts of these viruses, including flying foxes and horseshoe bats. This limitation is, in large part, due to the absence of facilities for housing and breeding bat colonies for distribution to investigators in the United States.

As you know, we have an active research program involved with understanding natural immunity to emerging viruses known or believed to circulating in bats including filoviruses, henipaviruses and coronaviruses, the latter two of which are known to circulate in the bat species you plan to initiate colonies with. Thus, we have great interest in collaborating with you both utilizing our state-of-the-art BSL3 and BSL4 containment laboratories here at the (b)(6) to conduct these studies. Further, we are also initiating a number of fields studies with partners at Duke-NUS in Singapore to examine stress responses in wild populations of these two species, so the ability to conduct controlled experiments to complement our findings in the field is of paramount importance to understanding maintenance of these viruses in nature.

In addition to expanding the availability of unique research models for studying the high priority infectious agents they are associated with, expansion of these facilities would enhance access to bat derived primary cell cultures, fresh bone marrow for immune cell studies, and generation of immortalized cell lines which will help determine how the viruses interact with bat cells, and how bat cells may respond to infection compared to human cells. Enhancement of the boarding capacity of the proposed facility will also strengthen the reliability of a robust biobank of bat cell derived from these species for the research community and provide long-term, sustainable research tools for our community.

CSU's experience maintaining tropical bat colonies to support state-of-the-art infectious disease research and develop unique research tools such as primary cells from known disease reservoirs is clearly a recipe for success for this application. We offer our strongest support and look forward to working with you on this project as it moves forward.

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Gregory Ebel, PhD
Director, Center for Vector-borne Infectious Diseases
Colorado State University
Fort Collins, CO 80523

10 Mar 2021

Dear Dr. Ebel,

I am happy to offer my support and expertise on your NIH C06 grant proposal, "*Bat Resource Center for the Study of Zoonotic Diseases*." I have 25 years of experience with housing bats, including flying foxes that are important reservoirs of many emerging and high consequence infectious diseases. This experience includes captive care, facility management, logistics, enrichment, medical management, and husbandry of bats. I have reviewed your construction plans for the proposed bat facility and they are exemplary for providing an environment that will facilitate establishment of breeding colonies of large fruit bats. As you know, flying foxes require large spaces for free-flight and the design of your facility will permit such flight, an important aspect for successful management and breeding of these species.

I am also happy to provide advice and guidance during and after the construction of your bat facility should you require it. Considering the importance of bats and their viruses that cause significant disease burden in humans, including the current COVID-19 pandemic, facilities such as this will be critical to gain a better understanding of how bats can host these viruses without disease and how the viruses manage to jump to humans. This knowledge will be key for the development of mitigation strategies to reduce the risk of their future transmission to humans.

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OMB Number: 4040-0010
Expiration Date: 12/31/2022

RESEARCH & RELATED Senior/Key Person Profile (Expanded)

PROFILE - Project Director/Principal Investigator

Prefix: First Name*: Gregory Middle Name David Last Name*: Ebel Suffix:

Position/Title*: Professor
Organization Name*: COLORADO STATE UNIVERSITY
Department:
Division: Microbiology, Immunology, & Pa
Street1*: 1685 Campus Delivery
Street2:
City*: Fort Collins
County:
State*: CO: Colorado
Province:
Country*: USA: UNITED STATES
Zip / Postal Code*: 80523-1685

Phone Number*: 970-491-8374 Fax Number:

E-Mail*: gregory.ebel@colostate.edu

Credential, e.g., agency login: (b)(6)

Project Role*: PD/PI Other Project Role Category:

Degree Type: SCD,SM,BA Degree Year: 2000,1997,1991

Attach Biographical Sketch*: File Name: Ebel_Biosketch.pdf

Attach Current & Pending Support: File Name:

Funding Opportunity Number: PAR-21-139 . Received Date: 2021-03-17T11:38:48.000-04:00

PROFILE - Senior/Key Person

Prefix: First Name*: (b)(6) Middle Name (b)(6) Last Name*: (b)(6) Suffix:

Position/Title*: (b)(6)
Organization Name*:
Department:
Division:
Street1*:
Street2:
City*:
County:
State*:
Province:
Country*:
Zip / Postal Code*:

Phone Number*: (b)(6) Fax Number:

E-Mail*: (b)(6)

Credential, e.g., agency login: (b)(6)

Project Role*: Other (Specify) Other Project Role Category: Facility manager

Degree Type: DVM,PHD,PHD,BA Degree Year: (b)(6)

Attach Biographical Sketch*: File Name: (b)(6)_Biosketch.pdf

Attach Current & Pending Support: File Name:

PROFILE - Senior/Key Person

Prefix: First Name*: (b)(6) Middle Name Last Name*: (b)(6) Suffix:

Position/Title*: (b)(6)
Organization Name*:
Department:
Division:
Street1*:
Street2:
City*:
County:
State*:
Province:
Country*:
Zip / Postal Code*:

Phone Number*: (b)(6) Fax Number:

E-Mail*: (b)(6)

Credential, e.g., agency login:

Project Role*: Other (Specify) Other Project Role Category: Project Manager

Degree Type: Degree Year:

Attach Biographical Sketch*: File Name: (b)(6)_Biosketch.pdf

Attach Current & Pending Support: File Name:

PROFILE - Senior/Key Person

Prefix: First Name*: (b)(6) Middle Name: (b)(6) Last Name*: (b)(6) Suffix:

Position/Title*: (b)(6)
Organization Name*:
Department:
Division:
Street1*:
Street2:
City*:
County:
State*:
Province:
Country*:
Zip / Postal Code*:

Phone Number*: (b)(6) Fax Number:

E-Mail*: (b)(6)

Credential, e.g., agency login: (b)(6)

Project Role*: Other Professional Other Project Role Category: Scientific advisor

Degree Type: PHD Degree Year: (b)(6)

Attach Biographical Sketch*: File Name: (b)(6)_Biosketch.pdf

Attach Current & Pending Support: File Name:

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Gregory D. Ebel	Professor
eRA COMMONS USER NAME (credential, e.g., agency login)	
(b)(6)	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
University of Minnesota	BA	03/91	English
Harvard School of Public Health	SM	06/97	Tropical Public Health
Harvard School of Public Health	Sc.D.	06/00	Immunology and Infectious Diseases

A. Personal Statement

In this project we propose to construct a building that will enhance CSU capabilities to conduct work on bats and bat-borne diseases. My qualifications to serve as PI of this proposal are both scientific and programmatic.

I am an arbovirologist with over 20 years' scientific experience investigating host-virus interactions of arthropod-borne flaviviruses. This work has included field studies of arthropod bionomics, molecular epidemiologic studies of arboviruses, and several observational and experimental studies of arbovirus evolution. My laboratory currently is funded to work on West Nile, Powassan, Zika and Chikungunya viruses, and also has projects that focus on Dengue viruses 1-4. A major focus in my laboratory also has been to create molecular tools to study arboviruses. In addition to NIH funding, we are supported by industry and defense partners for our work on mosquitoes and the viruses they transmit. An emerging aspect of my work concerns experimental evolution of bat-borne viruses within hosts. I anticipate being a major user of the proposed research infrastructure and thus am heavily invested in its success.

In addition to my role as a scientist and professor at CSU, since 2014 I have served as the director for the CSU Arthropod-borne and Infectious Diseases laboratory (AIDL). We are a group of nine faculty members with diverse expertise that ranges from metabolism and biochemistry to entomology and clinical/field studies. We are a highly collaborative and active group of researchers who genuinely enjoy working together. Upon assuming the directorship of AIDL, the most obvious deficiency was our outmoded and failing facilities that were poorly suited to our world-class research and training missions. To address this, CSU committed 22M to construct a new building to house AIDL and affiliated researchers and trainees. This building was completed in October 2020. Upon moving to the new building, we changed the name of the group to the CSU Center for Vector-borne Infectious Diseases (CVID). While much of our research remains centered upon arthropod vectors, bat vectors represent an increasing topic of research throughout the CVID. Construction of a new facility for bats is thus central to our vision for the future of our research.

Due to my personal scientific interest in the scientific environment at CVID, and my longstanding programmatic familiarity with our research and the infrastructure required to maintain it, I am ideally suited to serve as PI of this proposal.

1. Quicke K, Gallichotte E, Sexton NR, Young MC, Janich A, Gahm G, Carlton EJ, Ehrhart N and **Ebel GD** (2020) Longitudinal surveillance for SARS-CoV-2 RNA among asymptomatic staff in five Colorado skilled nursing facilities: epidemiologic, virologic and sequence analysis. *MedRxiv*. **doi:** https://doi.org/10.1101/2020.06.08.20125989 PMCID: PMC7302309.
2. Sexton NR, Bellis ED, Murrieta RA, Spangler MC, Cline PJ, Weger-Lucarelli J and **Ebel GD.** (2020) Genome number and size polymorphism in Zika virus infectious units. *J Virol.* 2020 Dec 16:JVI.00787-20. doi: 10.1128/JVI.00787-20. PMCID: currently online ahead of print.
3. Fagre A, Lewis J, Eckley M, Zhan S, Rocha SM, Sexton NR, Burke B, Geiss BJ, Peersen O, Kading R, Rovnak J, **Ebel GD**, Tjalkens RB, Aboellail T, Schountz T. (2020). SARS-CoV-2 infection,

neuropathogenesis and transmission among deer mice: Implications for reverse zoonosis to New World rodents. *bioRxiv*. Aug 7:2020.08.07.241810. doi: 10.1101/2020.08.07.241810. Preprint.

4. Ciminski K, Ran W, Gorka M, Lee J, Malmlov A, Schinkothe J, Eckley M, Murrieta RA, Aboellail TA, Campbell CL, **Ebel GD**, Ma J, Pohlmann A, Franzke K, Ulrich R, Hoffmann D, Garcia-Sastre A, Ma W, Schountz T, Beer M and Schwemmerle M. (2019) Bat influenza viruses transmit among bats but are poorly adapted to non-bat species. *Nat. Microbiol.* Sep 16. doi: 10.1038/s41564-019-0556-9.
5. Grubaugh ND, Fauver JR, Rückert C, Weger-Lucarelli J, Garcia-Luna S, Murrieta RA, Gendernalik A, Smith DR, Brackney DE and **Ebel GD**. (2017) Mosquitoes transmit unique West Nile virus populations during each feeding episode. *Cell Rep*.19(4):709-718. PMCID: PMC5465957.

B. Positions and Honors

Professional Appointments

2000-2006	**Research Scientist** at the Wadsworth Center Arbovirus Laboratories, New York State Department of Health
2004-2006	**Assistant Professor,** Department of Biomedical Sciences, The University at Albany, State University of New York.
2006-2010	**Assistant Professor,** Department of Pathology, University of New Mexico Health Sciences Center.
2010-2011	**Associate Professor,** Department of Pathology, University of New Mexico Health Sciences Center.
2011-2017	**Associate Professor,** Department of Microbiology, Immunology and Pathology, College of Veterinary Medicine and Biomedical Sciences, Colorado State University
2017-Present	**Professor,** DMIP, CSU
June 2014 – Present	**Director,** Arthropod-borne Infectious Disease Laboratory; Department of Microbiology, Immunology and Pathology, College of Veterinary Medicine and Biomedical Sciences, Colorado State University

Honors and Awards

2000	NYSDOH Commissioner's recognition award for involvement in New York State West Nile virus response team.
2000	Wadsworth Center Employee Recognition Award for involvement in West Nile virus response team.
2004	Scherer-Hardy Award, American Committee on Arthropod-Borne Viruses

National Service Activities. American Society for Tropical Medicine and Hygiene Scientific Program Committee (2008-Present), American Committee on Arthropod-borne viruses (ACAV) subcommittee for the evaluation of arthropod-borne status (2000-Present), ACAV executive council (2011-Present), ACAV executive council chair (2013-2014).

Ad-hoc Reviewer for National and International Funding Agencies. (Last five years)
NIH Clinical Research and Field Studies study section (Oct 2017); NIH Genetic Variation and Evolution Study section (February, 2015); NIH Vector Biology study section (June, 2015); NIH SEP Member Conflict (March 2016, July 2017, Nov 2018); NIH SEP Zika (May 2017). US Army MRMC, Discovery and Infectious Diseases applications (2016, 2017).

Ad-hoc Reviewer for Peer Reviewed Journals. Virology (Editorial Board Member); Journal of Virology; Journal of General Virology; Journal of Medical Virology, Journal of Virological Methods; Future Virology; Emerging Infectious Diseases; American Journal of Tropical Medicine and Hygiene; Vector-Borne and Zoonotic Diseases; BMC Evolutionary Biology; Journal of Medical Entomology; Molecular Ecology; The Condor; PLoS Pathogens, PLoS Neglected Tropical Diseases, PLoS One, Science Translational Medicine, Proceedings of the National Academy of Sciences of the USA, Genome Biology.

Memberships. American Society for Tropical Medicine and Hygiene (1997-Present), American Society for Virology (2003-Present).

C. Contribution to Science Students and fellows in my laboratory underlined.

A complete bibliography is available here: http://www.ncbi.nlm.nih.gov/pubmed/?term=Ebel+GD

1. Small RNA regulatory pathways in vector biology. We became interested in small RNA regulatory pathways in mosquitoes and their cells because our work on WNV repeatedly showed that virus populations in mosquitoes were more diverse than were those in vertebrates. This work is significant because it provides mechanistic explanations for this observation. It also demonstrates our expertise in miRNA sequencing and analysis.

1. Brackney DE, Scott JC, Sagawa F, Woodward JE, Miller NA, Schilkey FD, Mudge J, Wilusz J, Olson KE, Blair CD and **Ebel GD** (2010). C6/36 *Aedes albopictus* cells have a dysfunctional antiviral RNA interference response. *PLoS Negl. Trop. Dis.* 4(10): e856. doi:10.1371/journal.pntd.0000856. PMCID: PMC2964293.
2. Campbell CL, Harrison T, Hess AM and **Ebel GD.** (2014). MicroRNA levels are modulated in Aedes aegypti following exposure to Dengue-2. *Insect Mol. Biol.* Doi: 10.1111/imb.12070. PMCID: PMC4120961.
3. Brackney DE, Schirtzinger E, Harrison T, **Ebel GD** and Hanley KA. (2015) Modulation of flavivirus population diversity by RNA interference. *J. Virol.* 89(7):4035-9. doi: 10.1128/JVI.02612-14. Epub 2015 Jan 28. PMCID: PMC4403385 [Featured in JV "Spotlight"]
4. Moon SL, Dodd BJ, Brackney DE, Wilusz CJ, **Ebel GD** and Wilusz J (2015). Flavivirus sfRNA suppresses antiviral RNA interference in cultured cells and mosquitoes and directly interacts with the RNAi machinery. *Virology*. 485:322-329. PMCID: PMC4619171.

2. Biology of Zika virus. The emergence of Zika virus in the western hemisphere has resulted in explosive transmission and significant human suffering and economic loss. Our previous work on WNV and other flaviviruses was rapidly translatable to this new agent. Our contributions have been varied and are highlighted in the following publications.

1. Miner JJ, Sene A, Richner JM, Smith AM, Santeford A, Ban N, Weger-Lucarelli J, Manzella F, Rückert C, Govero J, Noguchi KK, **Ebel GD**, Diamond MS and Apte RS. (2016) Zika virus infection in mice causes pan-uveitis with shedding of virus in tears. *Cell Rep.* http://dx.doi.org/10.1016/j.celrep.2016.08.079. PMCID: PMC5040391
2. Weger-Lucarelli J, Duggal NK, Bullard-Feibelman K, Veselinovic M, Romo H, Nguyen C, Rückert C, Brault AC, Bowen RA, Stenglein M, Geiss BJ and **Ebel GD**. (2016) Development and characterization of recombinant virus generated from a New World Zika virus infectious clone. *J Virol.* 91(1). pii: e01765-16. PMCID: PMC5165210
3. Weger-Lucarelli J, Garcia SM, Ruckert C, Byas A, O'Connor SL, Aliota MT, Friedrich TC, O'Connor DH, **Ebel GD** (2018) Using barcoded Zika virus to assess virus population structure *in vitro* and in *Aedes aegypti* mosquitoes. *Virology* 521:138-148. PMCID: PMC6309320.
4. Magalhaes T, Robison A, Young M, Black WC IV, Foy B , **Ebel GD** and Rückert C. (2018) Sequential infection of Aedes aegypti mosquitoes with chikungunya virus and Zika virus enhances early Zika virus transmission. *Insects* 9(4), 177; https://doi.org/10.3390/insects9040177 – Special issue in honor of Professor Walter J. Tabachnik. PMCID: In progress.

3. Molecular Epidemiology of West Nile virus. WNV was introduced into North America in 1999. As a research scientist working under the direction of Dr. Laura Kramer at the Wadsworth Center, I led studies aimed at defining whether and how WNV adapted to transmission cycles in North America. These studies provided important insights into how the virus changed and showed that adaptation to mosquitoes occurred within a relatively short timeframe after introduction. Further this work provided and tested mechanistic explanations for presumed adaptive evolution using relevant *in vivo* study systems.

1. **Ebel GD**, Dupuis A, Ngo K, Nicholas D, Kauffman EB, Jones SA et al. (2001). Partial genetic characterization of West Nile virus strains isolated in New York State during the 2000 transmission

season. *Emerg. Inf. Dis*. 7(4): 650-653. PMCID: PMC2631742

2. Lanciotti RS, **Ebel GD**, Deubel V, Kerst AJ, Murri S, Meyer R et al. (2002). Complete genome sequence and phylogenetic analysis of West Nile Virus strains isolated from the United States, Europe and the Middle East. PMID: 12093177 *Virology*. 298: 96-105.
3. **Ebel GD**, Carricaburu JE, Young DS, Bernard KA, and Kramer LD (2004). Genetic and Phenotypic variation of West Nile virus in New York, 2000-2003. *Am. J. Trop. Med. Hyg*. 7(4):493-500. PMID: 15516648.
4. Snappin K, Holmes EC, Young DS, Bernard KA, Kramer LD and **Ebel GD** (2007). Declining growth rate of West Nile virus in North America. *J. Virol.* 81(5):2531-4. PMCID: PMC1865964.

4. Intrahost Diversity of RNA viruses. To define the selective and stochastic mechanisms that contribute to the formation and emergence of new viral genotypes, my lab has undertaken a series of studies on how different hosts (mosquitoes and birds) impact WNV diversity. These studies were at first dependent on Sanger sequencing, but recently have adopted next-generation sequencing approaches. As part of these studies we have developed and implemented new experimental tools for measuring virus fitness *in vivo* and computational tools for the accurate measurement of viral genetic diversity.

1. Deardorff ER, Fitzpatrick KA, Jerzak GVS, Shi PY, Kramer LD and **Ebel GD** (2011) West Nile virus experimental evolution in vivo and the trade-off hypothesis. *PLoS Pathog*. 7(11): e1002335. Doi:10.1371/journal.ppat.1002335. PMCID: 3213084
2. Macalalad AR, Zody MC, Charlebois P, Lennon NJ, Newman RM, Malboeuf CM, Ryan EM, Boutwell CL, Power KA, Brackney DE, Pesko KN, Levin JZ, **Ebel GD**, Allen TM, Birren BW and Henn MR. (2012). Highly sensitive and specific detection of rare variants in mixed viral populations from massively parallel sequence data. *PLoS Comput. Biol*. 8(3):e1002417. PMCID: 3305335.
3. Grubaugh ND, Smith DR, Brackney DE, Bosco-Lauth AM, Fauver JR, Campbell CL, Felix TA, Romo H, Duggal NK, Dietrich EA, Eike T, Beane JE, Bowen RA, Black WC, Brault AC and **Ebel GD**. (2015) Experimental evolution of an RNA virus in wild birds: evidence for host-dependent impacts on population structure and competitive fitness. *PLoS Pathog*. 11(5): e1004874. doi:10.1371/journal.ppat.1004874 PMCID: PMC4439088 [Featured on PLoS Pathogens Website 5/21/15.]
4. Grubaugh ND, Weger-Lucarelli J, Murrieta RA, Fauver JR, Garcia-Luna SM, Prasad A, Black WC IV, and **Ebel GD**. (2016) Genetic drift during systemic arbovirus infection of mosquito vectors leads to decreased relative fitness during host switching. *Cell Host Microbe*. 19(4):481-92.

5. Surveillance. My work as an arbovirologist has always had a focus on surveillance, including basic observational studies of value to public health. While this typically focuses on arboviruses, I have recently become interested in using information contained in mosquito bloodmeals to assess the health of human beings that have been fed upon. Surveillance remains a strong service orientation and part of my impact on science.

1. **Ebel GD**, Dupuis A, Nicholas D, Young D, Maffei D et al. (2002). Detection by enzyme linked immunosorbent assay of antibodies to West Nile virus in birds. *Emerg. Inf. Dis*. 8(9): 979-982. PMCID: PMC2732549
2. Young DS, Kramer LD, Maffei JG, Dusek RS, Backenson PB, Mores CN, Bernard KA, and **Ebel GD** (2008). Molecular epidemiology of eastern equine encephalitis virus epizootics in New York State. *Emerg. Inf. Dis.* 14(3):454-460. PMCID: PMC2570827.
3. Dusek R, McLean R, Kramer LD, Ubico S, Dupuis AP, **Ebel GD** and Guptil S. (2009) Prevalence of West Nile virus in migratory birds during spring and fall migration. *Am. J. Trop. Med. Hyg.* 81(6):1151-1158. PMID: 19996451.
4. Grubaugh ND, Sharma S, Krajacich BJ, Fakoli LS, Bolay FK, Diclaro JW II, Johnson WE, **Ebel GD**, Foy BD and Brackney DE. (2015) Xenosurveillance: a novel mosquito-based approach for examining the human-pathogen landscape. *PLoS Negl. Trop. Dis.* 9(3): e0003628. doi:10.1371/journal.pntd.0003628. PMCID: PMC4439088.

D. Research Support

Ongoing Research Support

R01AI067380-5 Ebel, GD (PI) 2007-2022
"Quasispecies Dynamics in Arbovirus Emergence, Persistence and Fitness." The major goal of this research is to determine whether intrahost genetic diversity contributes to the public health burden imposed by arthropod-borne RNA viruses.

R01AI137424 Telford S and Ebel GD (mPI) 2018-2023
"Emergence of tick-borne encephalitis in North America." The major goal of this research is to understand that factors that promote and/or limit the emergence of tick-transmitted flaviviruses in the US.

Completed Research Support (last 3 years)

R21AI129593 Ebel, GD (PI) 2017-2019
"Role of cell tropism for Zika virus transmission and pathogenesis." The major goal of this research is to define critical cells for transmission and pathogenesis in mosquitoes and mice, respectively. This project takes advantage of a newly developed ZIKV reverse genetics system into which we have engineered miRNA target sequences that silence virus replication in a cell-specific manner.

R21AI125996 Ebel, GD (PI) 2016-2018
"Predicting genetic determinants of Zika virus emergence." The major goals of this project are to define the likelihood that new world mosquitoes will impact ZIKV evolutionary dynamics and to assess the role of temperature during extrinsic incubation on virus population biology.

R21 AI109463 Black WC (PI) 2014-2016
"The role of RNAi in *Aedes aegypti* on dengue evolution." The major goal of this project is to assess how DENVs and components of the *Aedes* RNAi machinery interact to drive DENV evolutionary change. Role: Collaborator.

Colorado State University Infectious Diseases Supercluster Ebel, GD (PI) 2014-2016
"Xenosurveillance: A novel approach for interrogating the human-pathogen landscape in sub-Saharan Africa." The goal of this research is to optimize methods for detecting infectious agents within bloodfed mosquitoes for biological surveillance in resource-poor environments.

Training Grants & Fellowships as PI or Support for Ebel Trainees (Past five years)

NIH F31AI134108 Murrieta RD (Trainee) 2017-2020
"Temperature dependent impacts of RNA virus population evolution"

NIH T32OD010437 Hoover E (PI) Byas A (Trainee) 2018-2021
"Biomedical research training for veterinarians"

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Withheld pursuant to exemption

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of the Freedom of Information and Privacy Act

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of the Freedom of Information and Privacy Act

Page 90 of 94

Withheld pursuant to exemption

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of the Freedom of Information and Privacy Act

Page 91 of 94

Withheld pursuant to exemption

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of the Freedom of Information and Privacy Act

OMB Number: 4040-0010
Expiration Date: 12/31/2022

BUDGET INFORMATION - Construction Programs

NOTE: *Certain Federal assistance programs require additional computations to arrive at the Federal share of project costs eligible for participation. If such is the case, you will be notified.*

COST CLASSIFICATION	a. Total Cost	b. Costs Not Allowable for Participation	c. Total Allowable Costs (Columns a-b)
1. Administrative and legal expenses	22500.00		22500.00
2. Land, structures, rights-of-way, appraisals, etc.	22500.00		22500.00
3. Relocation expenses and payments	30000.00		30000.00
4. Architectural and engineering fees	662045.00		662045.00
5. Other architectural and engineering fees	0.00		0.00
6. Project inspection fees	310000.00		310000.00
7. Site work	0.00		0.00
8. Demolition and removal	0.00		0.00
9. Construction	6301789.00		6301789.00
10. Equipment	232996.00		232996.00
11. Miscellaneous	36600.00		36600.00
12. SUBTOTAL *(sum of lines 1-11)*	7618430.00	0.00	7618430.00
13. Contingencies	380920.00		380920.00
14. SUBTOTAL	7999350.00	0.00	7999350.00
15. Project (program) income	0.00		0.00
16. TOTAL PROJECT COSTS *(subtract #15 from #14)*	7999350.00	0.00	7999350.00
FEDERAL FUNDING			
17. Federal assistance requested, calculate as follows: (Consult Federal agency for Federal percentage share.) Enter the resulting Federal share.	Enter eligible costs from line 16c Multiply X 100%		$ 7,999,350.00

Funding Opportunity Number: PAR-21-139. Received Date: 2021-03-17T11:38:48.000-04:00

PHS 398 Cover Page Supplement

OMB Number: 0925-0001

Expiration Date: 02/28/2023

1. Vertebrate Animals Section

Are vertebrate animals euthanized? ○ Yes ● No

If "Yes" to euthanasia

Is the method consistent with American Veterinary Medical Association (AVMA) guidelines?

○ Yes ○ No

If "No" to AVMA guidelines, describe method and provide scientific justification

2. *Program Income Section

*Is program income anticipated during the periods for which the grant support is requested?

○ Yes ● No

If you checked "yes" above (indicating that program income is anticipated), then use the format below to reflect the amount and source(s). Otherwise, leave this section blank.

*Budget Period *Anticipated Amount ($) *Source(s)

Tracking Number: GRANT13324304

Funding Opportunity Number: PAR-21-139 . Received Date: 2021-03-17T11:38:48.000-04:00

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3. Human Embryonic Stem Cells Section

*Does the proposed project involve human embryonic stem cells? ○ Yes ● No

If the proposed project involves human embryonic stem cells, list below the registration number of the specific cell line(s) from the following list: http://grants.nih.gov/stem_cells/registry/current.htm. Or, if a specific stem cell line cannot be referenced at this time, check the box indicating that one from the registry will be used:

❑ Specific stem cell line cannot be referenced at this time. One from the registry will be used.

Cell Line(s) (Example: 0004):

4. Human Fetal Tissue Section

*Does the proposed project involve human fetal tissue obtained from elective abortions? ○ Yes ● No

If "yes" then provide the HFT Compliance Assurance

If "yes" then provide the HFT Sample IRB Consent Form

5. Inventions and Patents Section (Renewal applications)

*Inventions and Patents: ○ Yes ○ No

If the answer is "Yes" then please answer the following:

*Previously Reported: ○ Yes ○ No

6. Change of Investigator/Change of Institution Section

❑ Change of Project Director/Principal Investigator

Name of former Project Director/Principal Investigator

Prefix:

*First Name:

Middle Name:

*Last Name:

Suffix:

❑ Change of Grantee Institution

*Name of former institution:

Tracking Number: GRANT13324304 Funding Opportunity Number: PAR-21-139 . Received Date: 2021-03-17T11:38:48.000-04:00