Biosafety Guidance for Contained Research with Arthropod Vector Species

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Existing biosafety guidance for working with vectors and vector-borne pathogens

- Biosafety in Microbiological and Biomedical Laboratories
- Arthropod Containment Guidelines
  - Original:
    - VECTOR-BORNE AND ZOONOTIC DISEASES Volume 3, Number 2, 2003
  - Revised:
    - VECTOR-BORNE AND ZOONOTIC DISEASES 2019 Mar 1; 19(3): 152–173.

Fundamentals of arthropod containment

- Risk assessment and mitigation
  - Vector species
    - Flight risk and invasion potential
  - Pathogen species
    - Flight risk and invasion potential
- Research assurances and institutional approvals
- Lab design
- Lab practices

Risk assessment and mitigation

- *Lab personnel*
- *Building occupants*
- *Community*
- *Region*

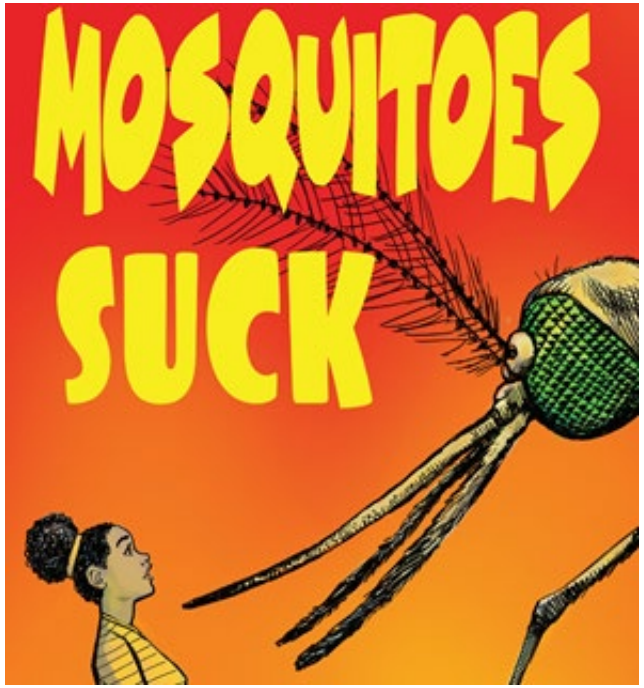

Table 1. Summary of Arthropod Containment Levels

Arthropod containment level (ACL)	*1*		*2*	*3*[a]	*4*[a]
Arthropods free of specific pathogens	*Indigenous/no change in local fauna*	*Exotic/inviable or transient only*	*Exotic with establishment potential or transgenic*	*n/a*	*n/a*
Infection status	Up to BSL-1		Up to BSL-2	Up to BSL-3	Up to BSL-4
Practices	ACL-1 standard handling practices		ACL-2 and BSL-2 limited access, training, signage, containment, and disposal	ACL-3 and BSL-3 restricted access, training, appropriate PPE, signage, containment, disposal, record-keeping[a]	ACL-4 with BSL-4 isolation, training, appropriate PPE, signage, containment, disposal, record-keeping[a]
Primary barriers	Species-appropriate containers		Appropriate PPE, escape-proof containers	Appropriate PPE, escape-proof containers, pesticide available for emergency use[a]	Appropriate PPE, escape-proof containers, pesticide available for emergency use[a]
Secondary barriers			BSL-2 facilities, breeding sites, and harborage minimized, pest control	BSL-3 facilities, biological safety cabinets, other physical containment devices, pest control[a]	BSL-4 and facility-specific procedures and equipment for arthropod handling while wearing positive pressure containment suit[a]

General guidelines for best laboratory containment practices are shown for vector species of arthropod that are uninfected (*above the bold line*) or infected (*below the bold line*) according to biosafety and ACLs. Indigenous species are those species whose current range includes the research location. All others are considered exotic. For uninfected arthropods, containment guidelines take into account the consequences of accidental escape from a laboratory, in which the arthropod would be (1) inviable as a result of exposure to unfavorable conditions; (2) transient because conditions vary such that the arthropod would die during typical year climate cycle; or (3) has potential for establishment because escaped arthropods could reasonably be expected to persist through a typical climatic year. Arthropod containment specifics for each BSL should always be reviewed in the context of a laboratory-, vector-, and pathogen-specific risk assessment that is based on consultation between the investigator and the appropriate institutional oversight committee(s) and according to the constraints of the infrastructure available.

[a]Additional restrictions apply for work with arthropods in association with Select Agents.

ACL, arthropod containment level; BSL, biosafety level; PPE, personal protective equipment.

Arthropod containment Level (ACL)	*2*
Arthropods free of specific pathogens	*Exotic with establishment potential or transgenic*
Infection status	Up to BSL-2
Practices	ACL-2 and BSL-2 limited access, training, signage, containment, and disposal
Primary barriers	Appropriate PPE, escape-proof containers
Secondary barriers	BSL-2 facilities, breeding sites, and harborage minimized, pest control

Basics of containment @ACL2

- BSL2 basics (limited access, signage)
- Lab design maximizes
  - Containment
    - rearing space is internal to the lab
    - physical barriers (fabric, screen or air curtain, sealed vents, mutiple doors/anteroom)
    - Dedicated area for working w/ high risk arthropods
  - Detection of escapees (white surfaces, closed storage, reduce clutter)
- Lab practices further mitigate risk
  - Standard Operating Procedures/Safety Manual
  - PPE
  - Escape-proof rearing/holding
  - Notification (signage, labeling, training)
  - Escapee monitoring
  - Proper disposal
  - Source/harborage reduction

Best practices for working with vectors and assoc. pathogens

Best practices for working with vectors and VBPs

Best practices for working with vectors and VBPs

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Labs that have ongoing work w/ vectors are likely designed to adapt to containment for gene drive . . .

Current ACL guidelines are designed for research using infectious agents.

Recommendations for Laboratory Containment and Management of Gene Drive Systems in Arthropods

Mark Q. Benedict, Austin Burt, Margareth L. Capurro, Paul De Barro, Alfred M. Handler, Keith R. Hayes, John M. Marshall, Walter J. Tabachnick, and Zach N. Adelman

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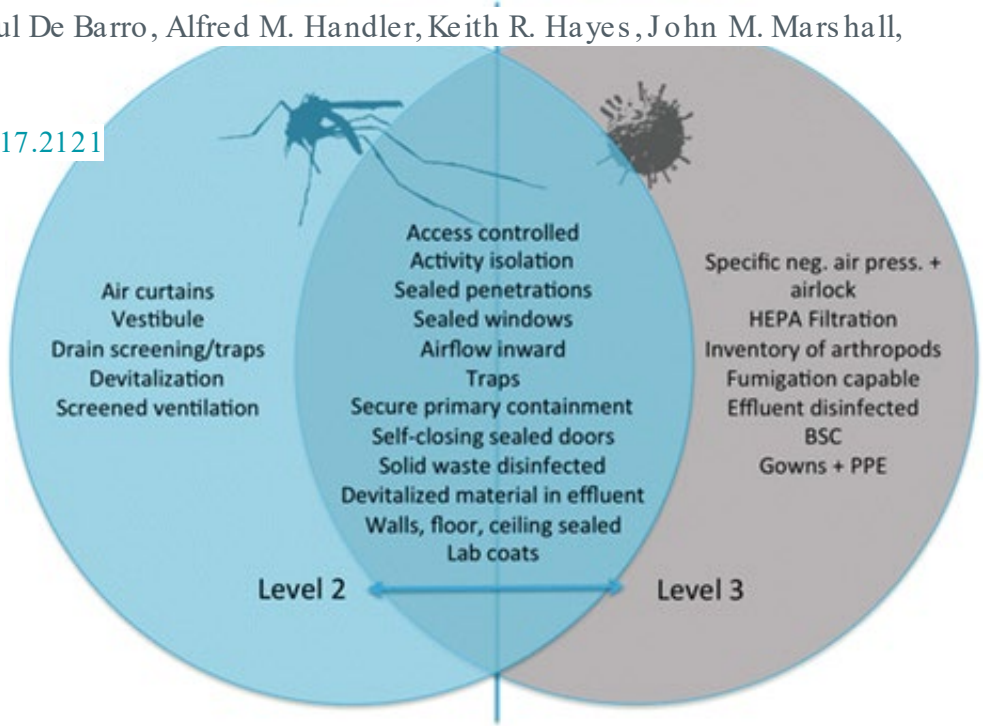

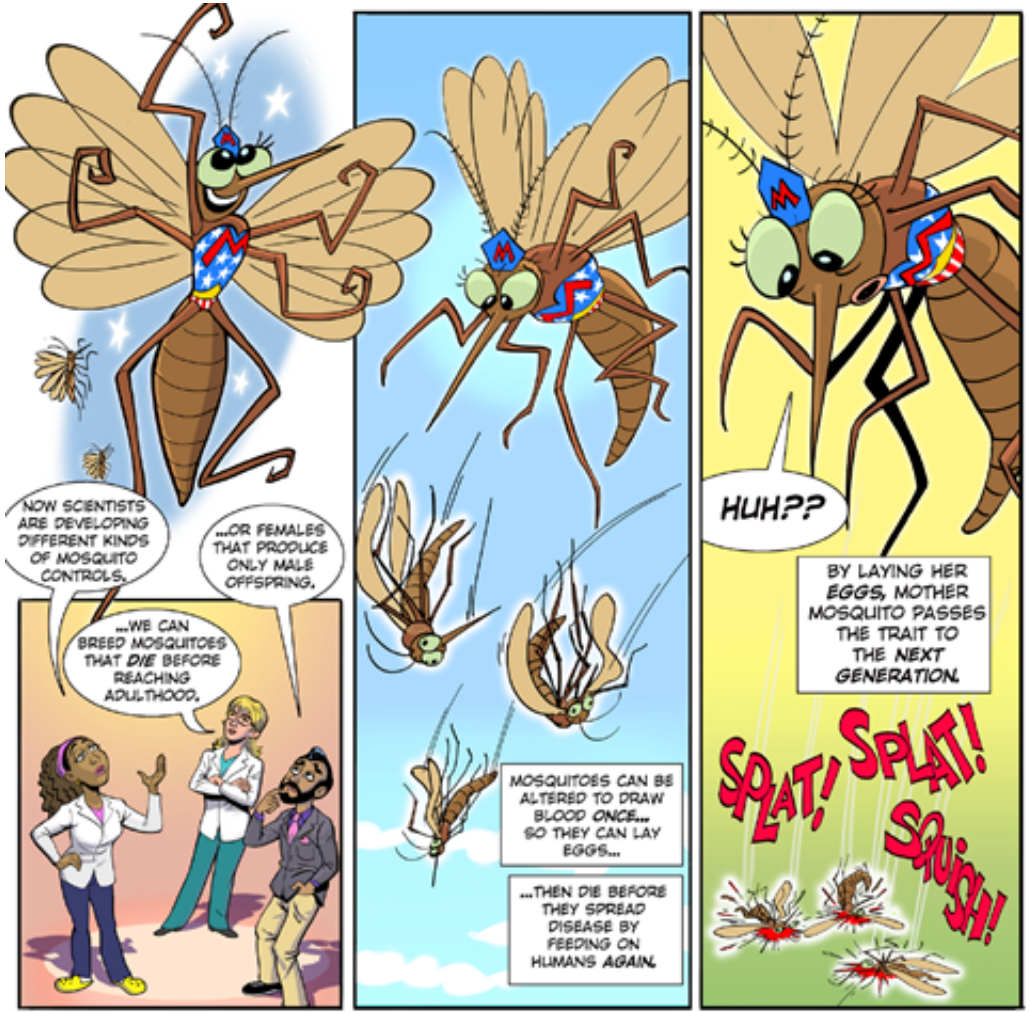
NOW SCIENTISTS ARE DEVELOPING DIFFERENT KINDS OF MOSQUITO CONTROLS.
...WE CAN BREED MOSQUITOES THAT DIE BEFORE REACHING ADULTHOOD.
...OR FEMALES THAT PRODUCE ONLY MALE OFFSPRING.
MOSQUITOES CAN BE ALTERED TO DRAW BLOOD ONCE... SO THEY CAN LAY EGGS...
...THEN DIE BEFORE THEY SPREAD DISEASE BY FEEDING ON HUMANS AGAIN.
HUH??
BY LAYING HER EGGS, MOTHER MOSQUITO PASSES THE TRAIT TO THE NEXT GENERATION.
SPLAT! SPLAT! SQUISH!