USAMRIID

Working Safely with Rift Valley fever virus

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Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the U.S. Army.

Research was conducted in compliance with the Animal Welfare Act and other federal statutes and regulations relating to animals and experiments involving animals and adheres to principles stated in the *Guide for the Care and Use of Laboratory Animals*, National Research Council, 1996. The facility where this research was conducted is fully accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care International.

Rift Valley fever:

Human or animal disease?

Disease - Humans

- Usually a “mild” febrile illness
- Incubation period: 2-6 days
- More serious disease
  - Encephalitis (<1%)
  - Hemorrhagic fever (<1%)
  - Ocular disease
- Case fatality rate (usually ~1%)

Disease

Livestock (cattle, goats, sheep)

Pregnant animals:	**abort/die**
Adult animals:	**mild disease**
Young animals:	**>90 fatality**

Prior outbreaks

- **First described in 1931**
- **Various outbreaks in sub-Saharan Africa**

  Kenya, South Africa, Rhodesia (Zimbabwe)
- **Egyptian Outbreak - 1977**

  Estimated 200,000 human cases

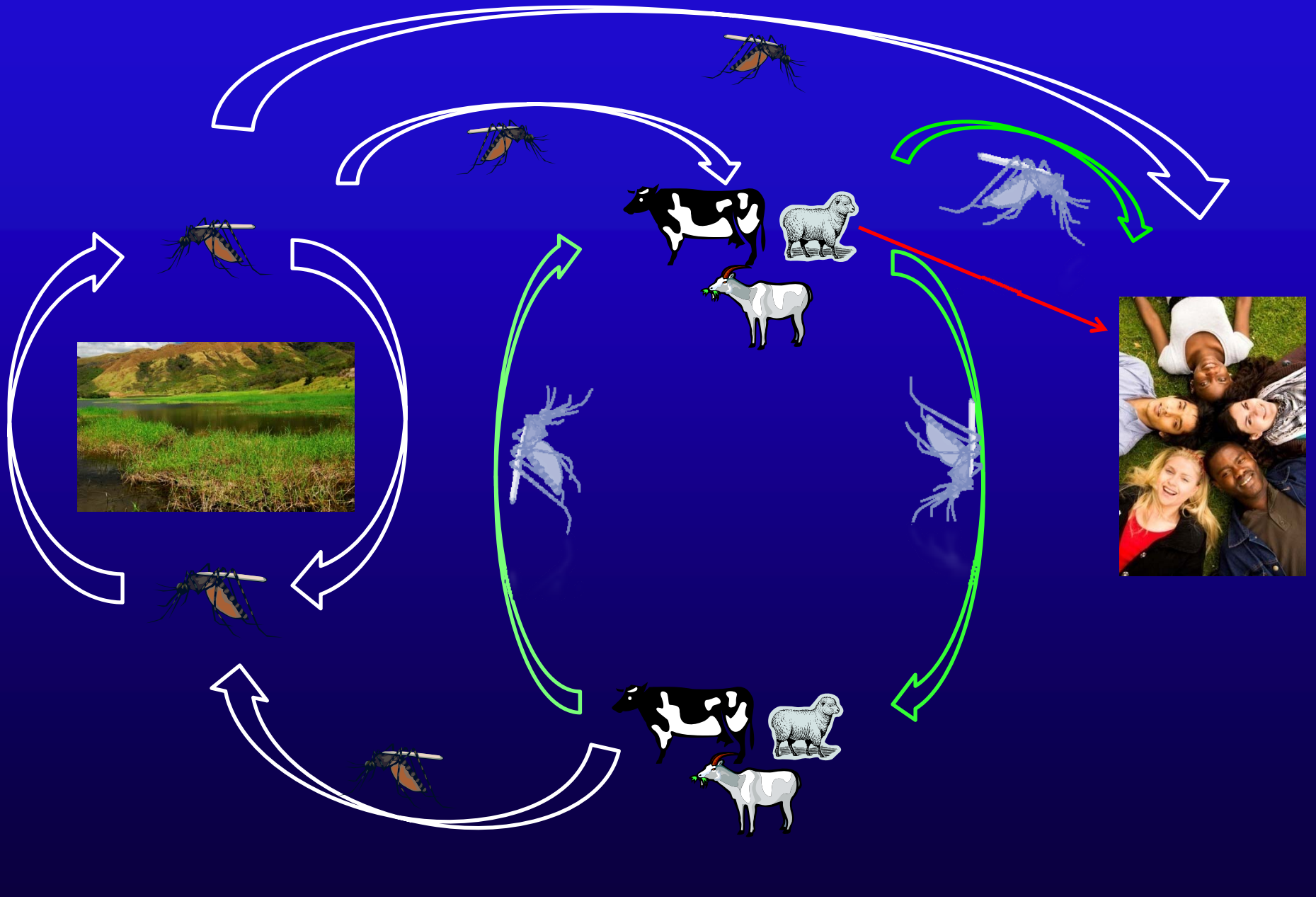
  598 reported deaths (estimated at 20,000)

  First report of RVFV outside of sub-Saharan Africa

Recent outbreaks

- **Saudi Arabia/Yemen – 2000-2001**
- **Kenya – 2006-2007**
- **Sudan – 2007-2008**
- **South Africa – 2010**
- **Mauritania – 2010**

Overview of Rift Valley fever virus



WHAT DO WE KNOW ABOUT POTENTIAL VECTORS IN NORTH AMERICA?

Criteria for Vector Incrimination

- **Repeated isolation of virus from field-collected individual of species**

- **Association in nature between the arthropod and naturally infected vertebrate hosts**

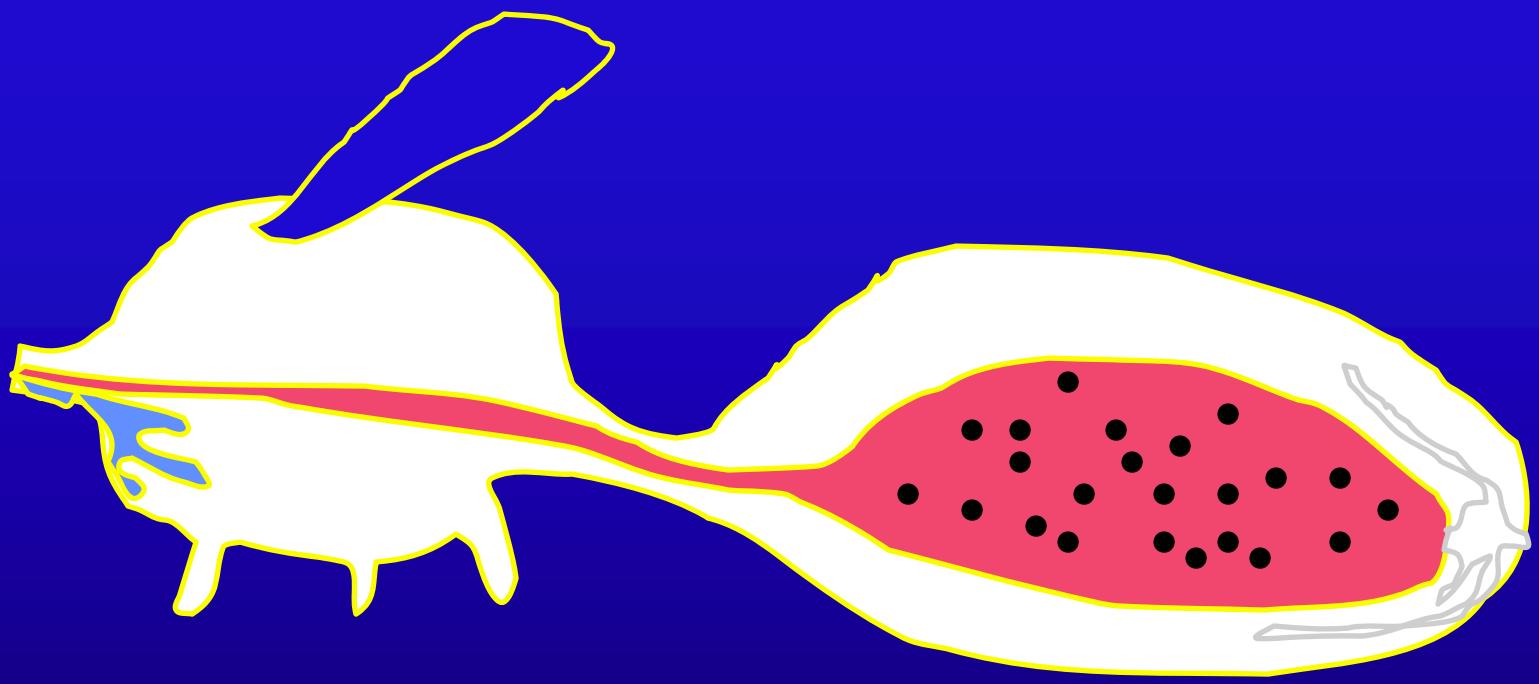
- **A temporal association between the arthropods' activity and viral transmission**

Criteria for Vector Incrimination

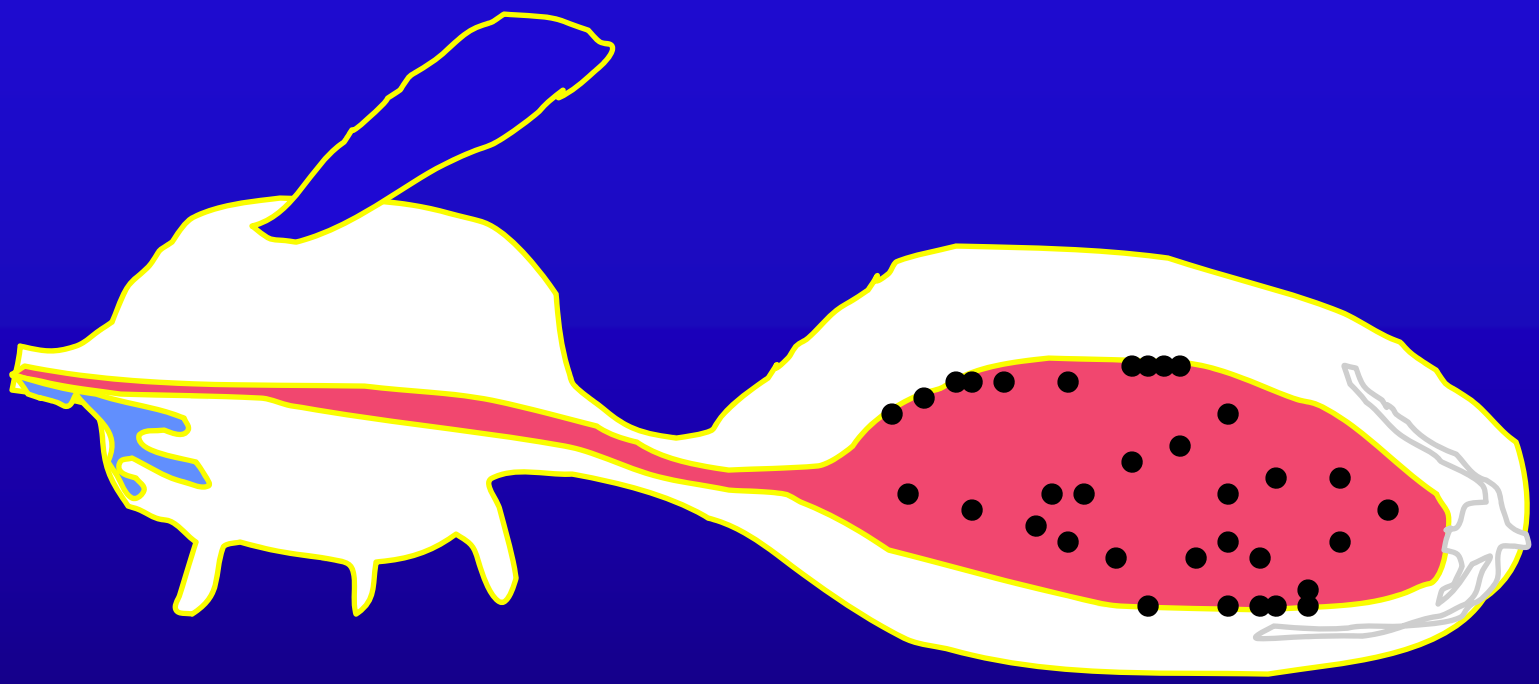
- **Susceptibility of the arthropod to infection in the laboratory**

- **Ability of the arthropod to transmit the virus in the laboratory**

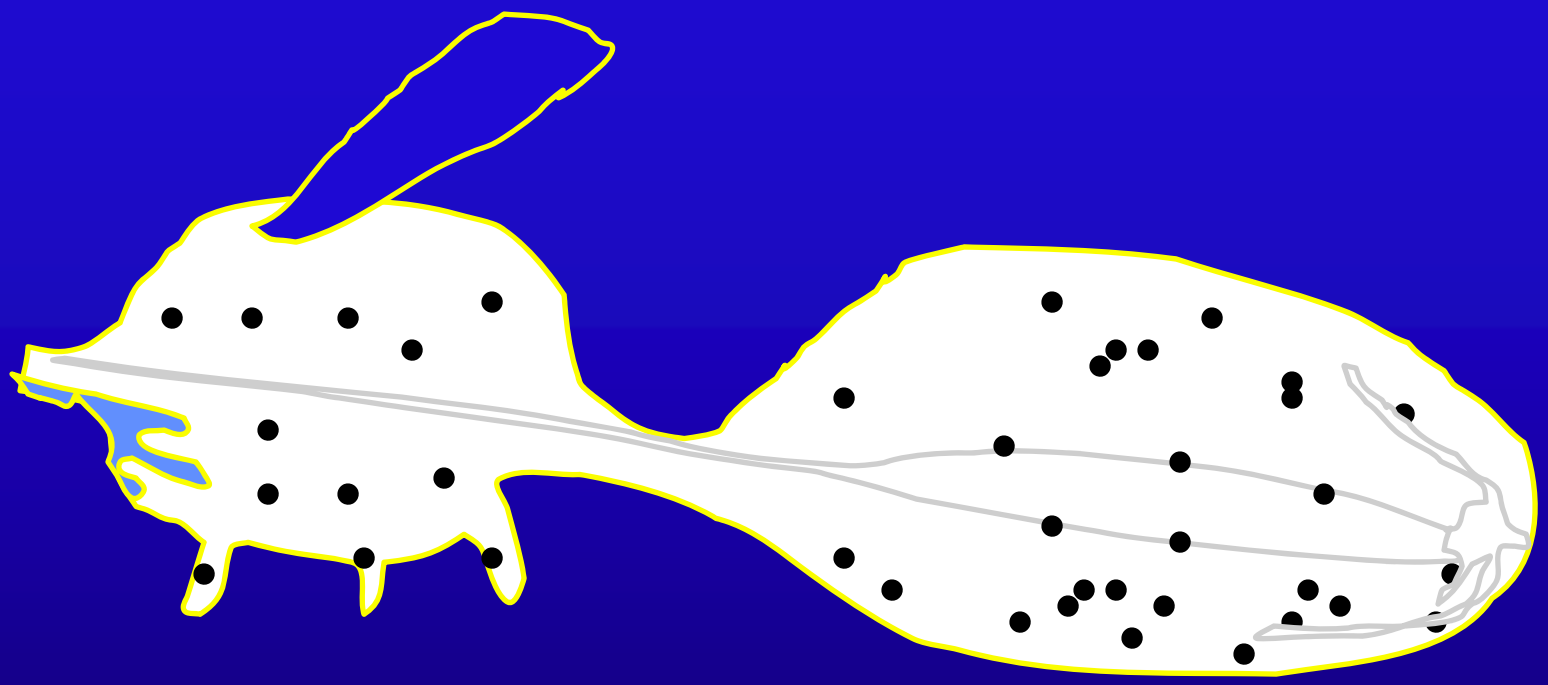
Vector Competence



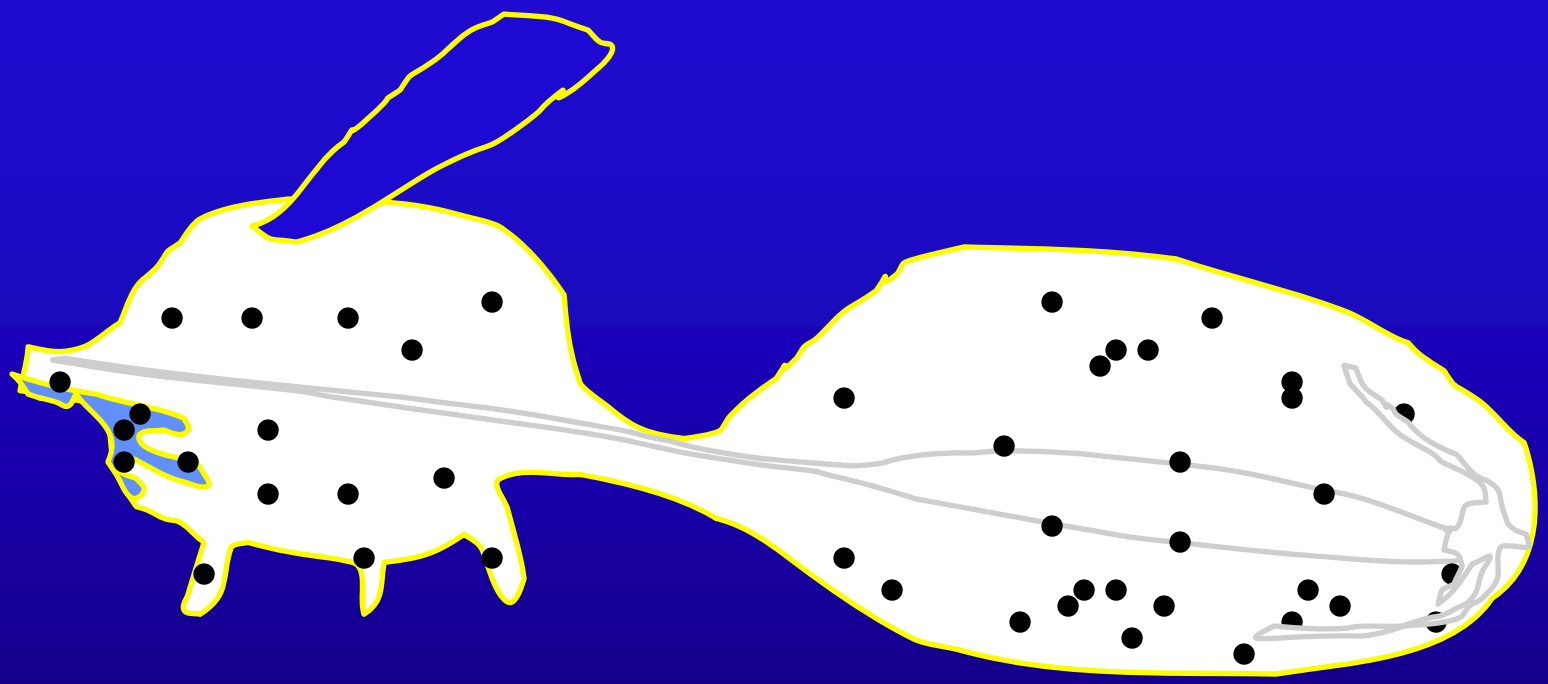
Virus in the blood meal, but mosquito not infected



Mosquito infected, but limited to midgut



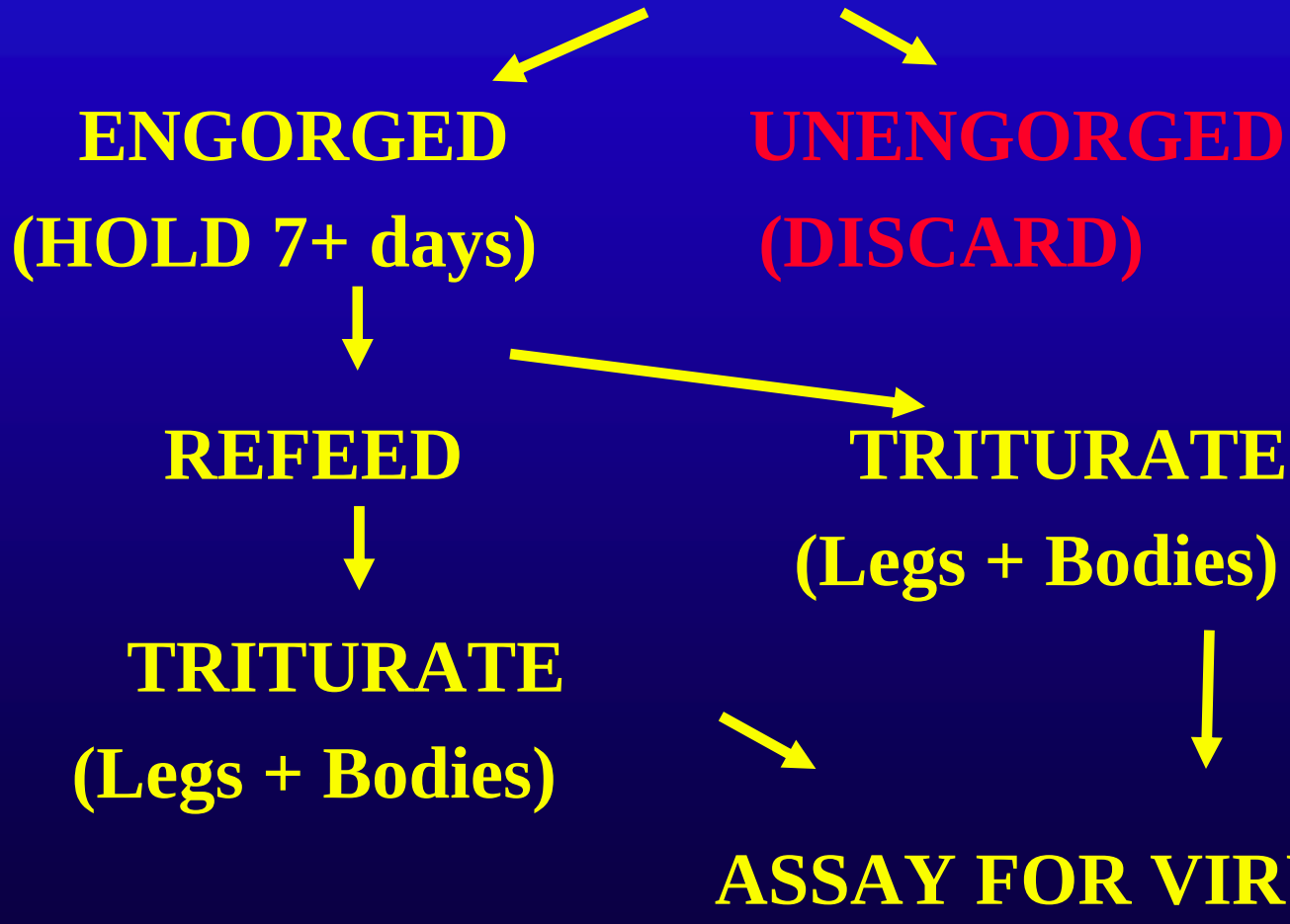
Virus disseminated to hemocoel,
but salivary glands not infected



Salivary glands infected, ready to transmit by bite

STUDY PROCEDURE

ALLOW MOSQUITOES TO FEED ON INFECTED ANIMAL



Known Potential Vectors

Relatively efficient

Aedes canadensis

Ae. sollicitans

Ae. taeniorhynchus

Culex tarsalis

Known Potential Vectors

Moderately efficient

Aedes cantator

- ***Ae. excrucians***
- ***Ae. triseriatus***
- ***Ae. vexans* (LA/FL)**

Culex territans

- ***Cx. salinarius***
- ***Cx. (Mel.) erraticus***
- ***Cx. pipiens***
- ***Cx. erythrothorax***

Known Potential Vectors

Inefficient

Anopheles bradleyi/crucians

An. quadrimaculatus

Culex nigripalpus

Cx. quinquefasciatus

Aedes dorsalis

***Ae. vexans* (CO/CA)**

POTENTIAL FOR BECOMING ESTABLISHED IN NORTH AMERICA

Many North American mosquito species are potential vectors of RVF virus

Ample supply of susceptible domestic vertebrate hosts (cattle, goat, sheep)

Role of deer, horses, rodents, etc. is not known

Working safely with Rift Valley fever virus

HAZARDS

1. Stable virus
2. History of laboratory infections
3. Humans produce a viremia
4. Aerosol infection possible
5. Select agent

BIOSECURITY

How does one get into an area where research with live RVFV is being conducted?

“limited access”

BIOSURITY

CDC registration/inspections

Agent inventory

Rules for agent transfer/transport

Personal reliability profile

SAFETY

How do we protect the outside world

1. Training
2. Animal biosafety level-3 laboratory with 100% clothes change and shower out
3. Multiple doors/screens
4. Mosquito traps


SUNOCO

SAFETY

How do we protect the outside world

5. Emergency mosquito control


EMERGENCY
MOSQUITO
CONTROL
Remove plastic piece on side.
Depress button (ensure that it is pointing away from face).
Place on a table and leave the room for 4 hour
Raid
Concentrated

SAFETY

How do we protect the outside world

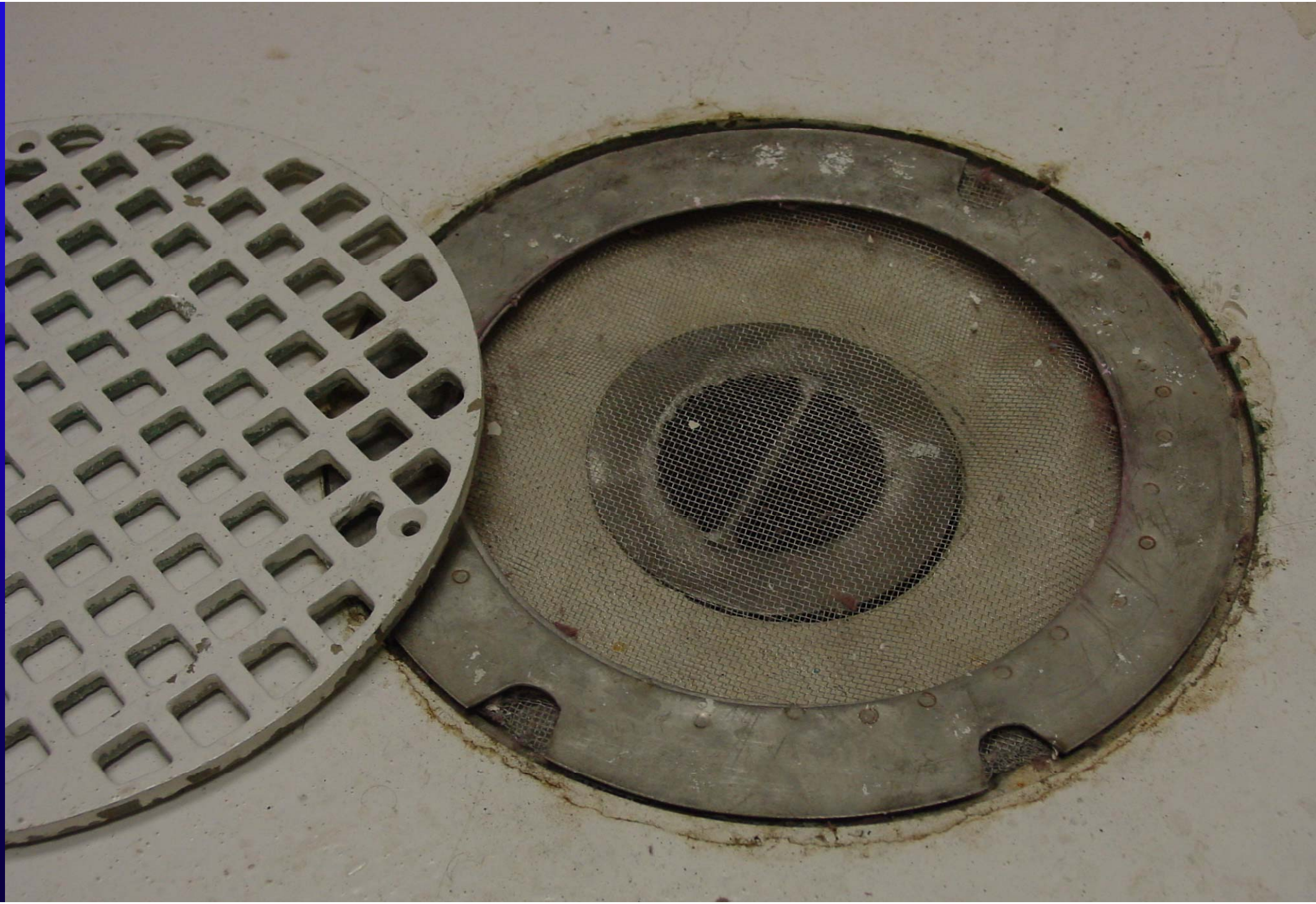
5. Emergency mosquito control
6. Walls painted white


TICKS

SAFETY

How do we protect the outside world

5. Emergency mosquito control
6. Walls painted white
7. Drains screened



SAFETY

How do we protect the outside world

5. Emergency mosquito control
6. Walls painted white
7. Drains screened
8. Autoclave all waste out


EMERGENCY EXIT
ONLY
HIGH IMPORTANT
ATTENTION!
MAKE SURE
NEVER LEAVE
ANYTHING IN
FRONT OF THIS DOOR
HOT SUITE/AA1
EMERGENCY DOOR ONLY
ALPHA-dri
ALPHA-dri
Castle
Castle

SAFETY

How do we protect the researcher

1. Training
2. Vaccination
3. Primary engineering controls
   a. Biological safety cabinets


D1626
SterilGARD Hood
CLASS II TYPE A/B3
the BAKER COMPANY, inc.
SANFORD, MAINE
SPACE
PERFORMANCE CERTIFICATION
WARNING
CAUTION
WARNING
D4331


INCHES OF WATER
.5 .4 .3 .2 .1 0 .1 .2 .3 .4 .5
MAGNEHELIC®
MAX. PRESSURE 15 PSIG
CAT. NO. 2301
CAUTION
PRESSURE
MAX. 15 PSIG
TEMPERATURE
MAX. 140°F

SAFETY

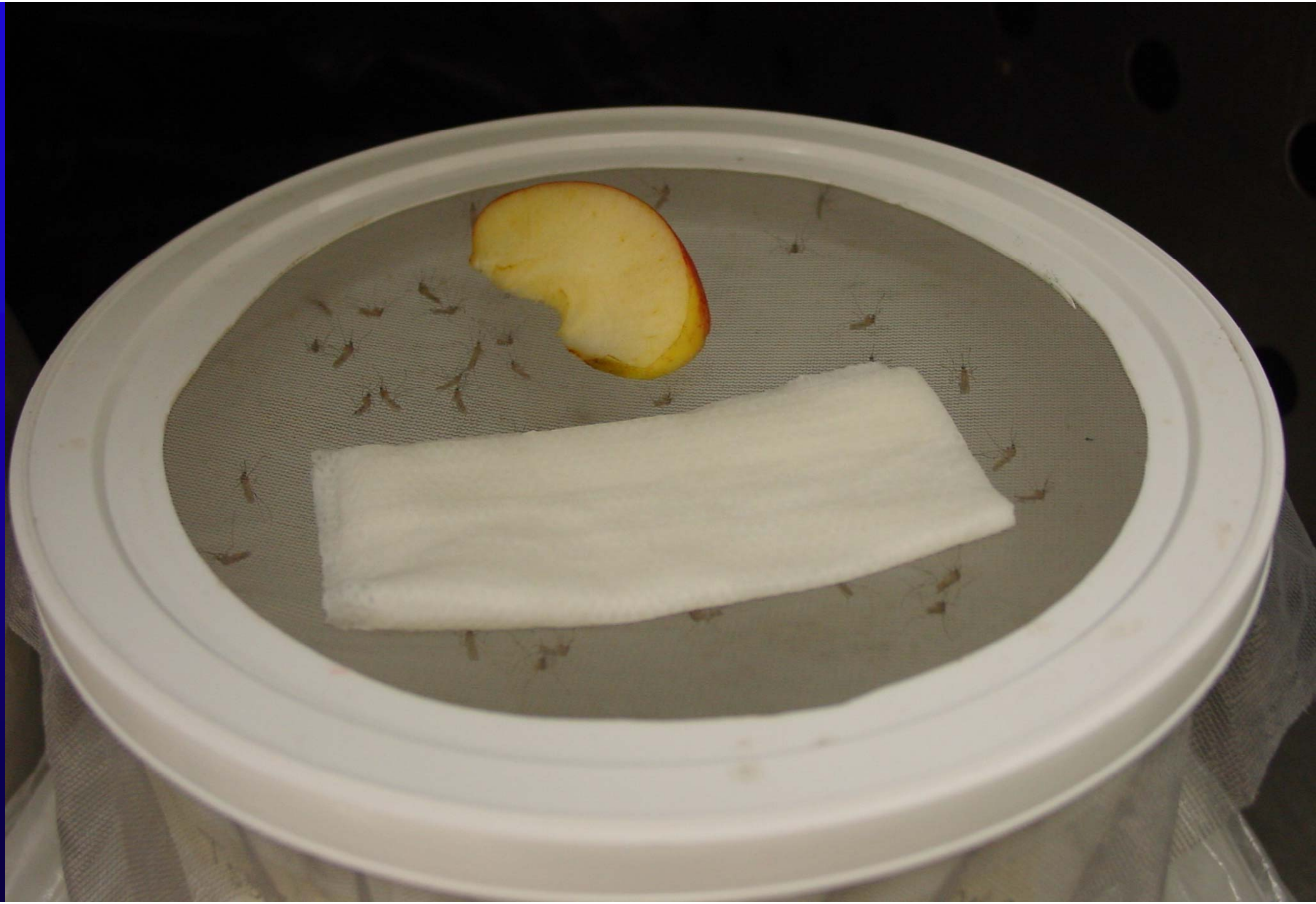
How do we protect the researcher

1. Vaccination
2. Primary engineering controls
   a. Biological safety cabinets
   b. Multiple layers of caging


Forma Scientific
RESPONSE TO SPILLS OUTSIDE BSL-4 SUITES
DOOR
BLOCKED


Fisher Scientific
4:42
25.4
35%


T558 Pupae
4:41
25.6°C
36%



SAFETY

How do we protect the researcher

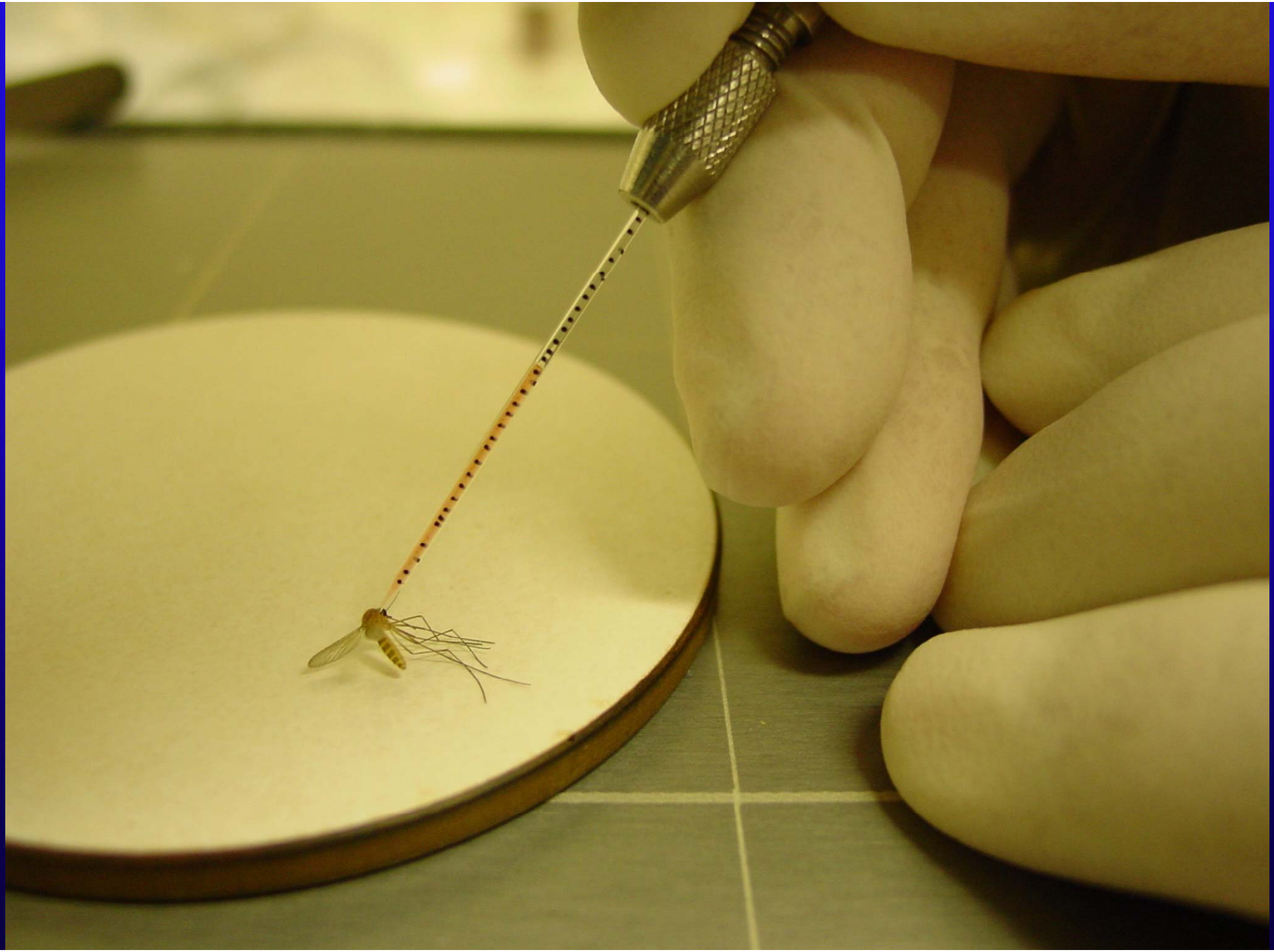
1. Vaccination
2. Primary engineering controls
   a. Biological safety cabinets
   b. Multiple layers of caging
   c. Filter bonnet cages in animal room


AA1/110
A1/110
SANITATION DATE
08-4-10 JW
08-16-10 JW
09-14-10 JW
09-30-10 JW
11-11-10 JW

SAFETY

How do we protect the researcher

1. Vaccination
2. Primary engineering controls
   a. Biological safety cabinets
   b. Multiple layers of caging
   c. Filter bonnet cages in animal room
3. Personal protective equipment (PPE)




WARNING
CAUTION
ULTRA VIOLET
WYPALL L10
EVOLUTION ONE

SUMMARY

- RVFV poses a real threat should it be introduced into North America.

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- **We need to have a better understanding of its epidemiology.**
  - vectors, diagnostics, vaccines

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- RVFV poses a real threat should it be introduced into North America.

- We need to have a better understanding of its epidemiology:

  vectors, diagnostics, vaccines.

- **These studies need to be conducted in a safe manner that will not endanger either the researcher or the public.**