THE UNIVERSITY OF ARIZONA
Agriculture, Life & Veterinary Sciences & Cooperative Extension

ARIZONA PEST MANAGEMENT CENTER

Communicable Pests - head lice, body lice, scabies mites, bed bugs

Shujuan (Lucy) Li, Ph.D.

Associate in Extension, Public Health IPM

Arizona Pest Management Center

Department of Entomology, University of Arizona

lucyli@email.arizona.edu

Head Lice

- Blood feeding ectoparasites* associated with the scalp. *Pediculus humanus capitis*
- More commonly found in school age students (3-11 years old) and girls.

* Ectoparasites are parasites that live on the surface of a host.

- Head lice transmission can occur:
  - **Primarily through direct head-to-head contact**
  - **Sharing bedding or clothing** (e.g. slumber parties, camps)

    E.g., Shelter of last resort for Katrina, >30,000 people seeking shelter in the Superdome

Why are head lice cases increasing?

- Control methods-related issues
  - Pediculicides (lice shampoo) with changes in formulation or ingredient, improper use of pediculicides, insecticide resistance (Mumcuoglu et al. 2020. Int J Dermatol).
- Increase in global and domestic travel
  - In the Americas, the prevalence of infestation in different countries varies from 2 to 80%; the countries of South America had the highest prevalence of lice (Falagas et al. 2008. *Emerging Infectious Diseases*).
  - A survey in Argentina showed the prevalence of head lice was 69.6% before COVID-19 lockdown (Galassi et al. 2021. *Parasitology Research*).
- Hair extensions & wraps
- Busier parents and guardians
- **The "selfie"**

What was really behind the “selfie”?

- Selfie culture is huge on social media.
- Google reported in mid-2019 that its Android devices take 93 million selfies per day.
- 18-to-24-year-olds reported that every third photo they take is a **selfie.**

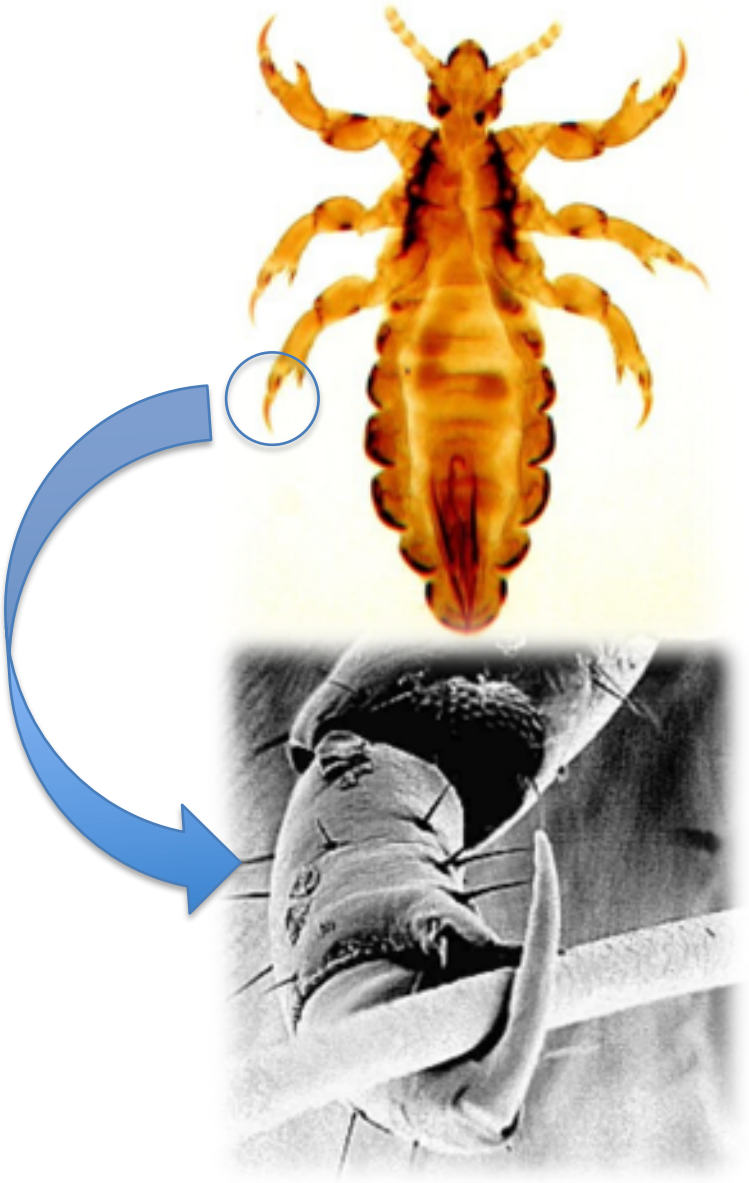
Two Extension Entomologists in a selfie ☺

What was really behind the “selfie”?

Image: Shujuan (Lucy)Li

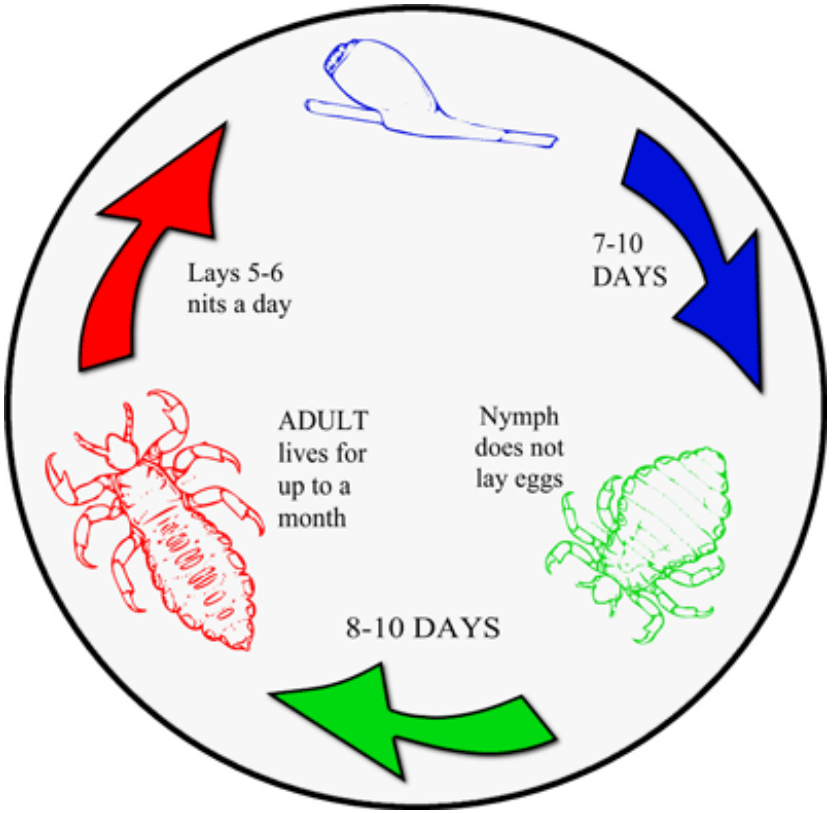
Head lice facts

- Size of a sesame seed (2-3 mm long). Tan in color.
- Crawl rapidly using claw-like legs across the scalp.
- Cannot fly or jump.
- Die off scalp within 2 days.
- $1 billion US cost (Hansen and O'Haver, 2004).

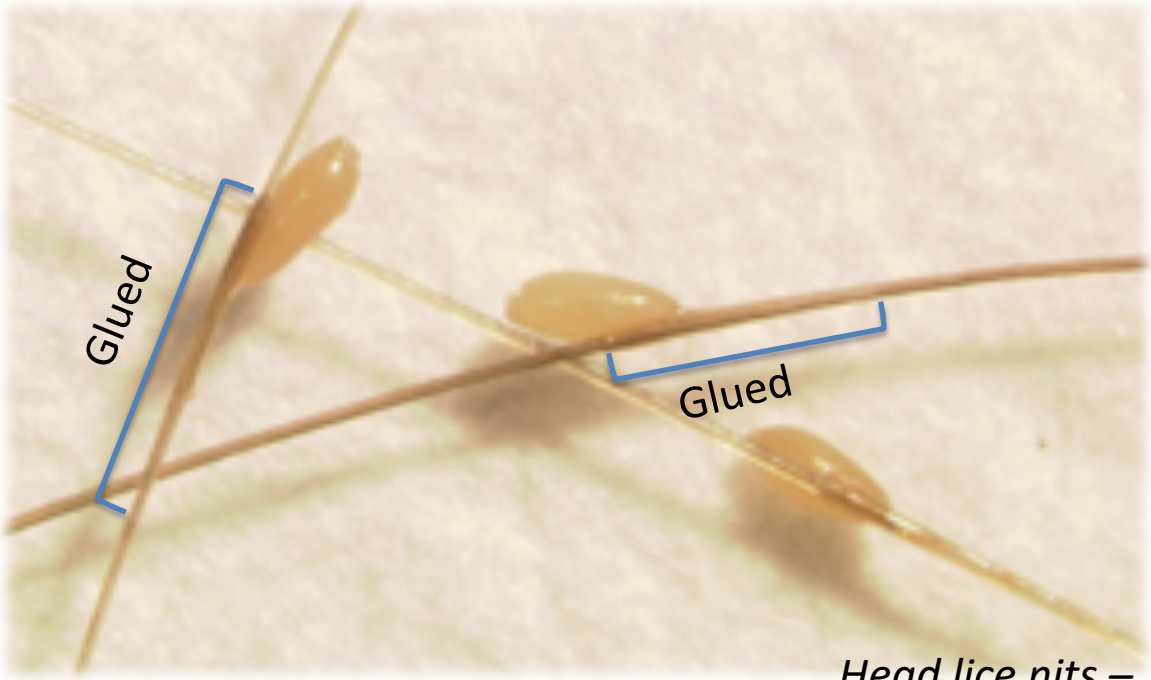


Images: Shujuan (Lucy)Li

- Cause itching and sleeplessness.
- Scratching may lead to secondary skin infections.
- If not treated, life cycle may repeat itself every 3 weeks.



- Females attach eggs (or nits) to hair 1 mm from the scalp.
- Nits need body warmth.
- Unhatched eggs are not obvious.
- Nits are easily seen at the hairline.



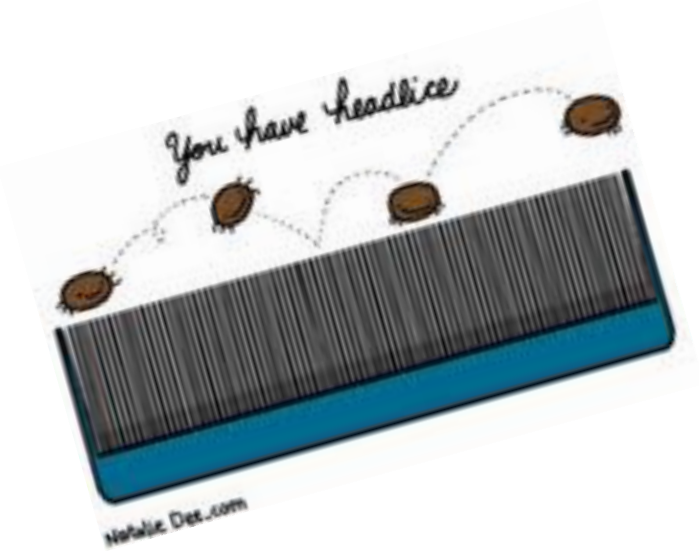
Head lice nits –
Shujuan Li, University of Arizona

- **Nits more than ½ inch away from the scalp** are nearly always hatched or dead and **do not,** by themselves, **indicate an active infestation or a need for treatment.**

- Treatment is recommended only for individuals found with **live lice.**

- Do not transmit disease-causing organisms.
- Cannot survive on pets.

Head lice – a pest you should <u>not</u> worry about in a crisis



- During crisis
  - Don't worry too much, plan to deal with it later
- <u>After</u> crisis support
  - Science-based information distributed
  - Clinic, medical center, school, childcare facility support
  - Say "NO" to the "No nit" school policies

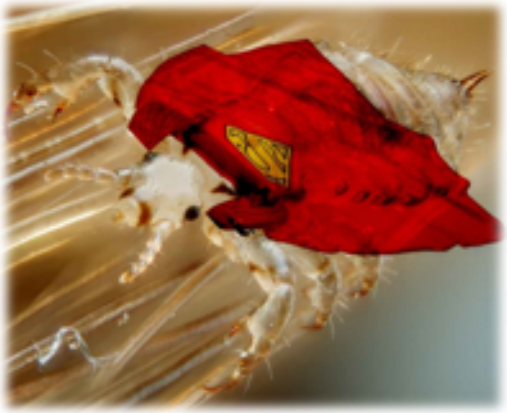
Treatment of Head Lice

Lice shampoos (Pediculicides)

- Contain insecticides (Pyrethrins, Permethrin, Lindane, Malathion, etc)
- Always carefully read and follow label directions
- Use it correctly!
- Resistance may occur

Never use gasoline or spray insecticides to treat lice.

Head lice are resistant to common OTC pediculicides



(Gellatly et al. 2016)

Switch to a different product that does not contain the same active ingredient

Prescription lice treatment options

- Resistant lice may need prescription treatment.
- **Newly FDA approved** prescription **Xeglyze™ Lotion** (abametapir 0.74% + benzyl alcohol).
- **Natroba Topical Suspension** (spinosad 0.9% + benzyl alcohol)
- **Sklice Lotion** (ivermectin 0.5%)

Prescription treatments for head lice

Active or excipient* ingredient	Mode of action	Product example
Benzyl alcohol*	Suffocates	Natroba™, Xeglyze™
Ivermectin	Disrupts nervous system	Stromectol and generics
		Sklice® Lotion
Spinosad*	Disrupts nervous system	Natroba™
Abametapir*	Metalloproteinase (enzyme) inhibitor	Xeglyze™
Pyrethroid-based[1,2]	Disrupts nervous system	Elimite, Acticin, etc.
Malathion[2]	Disrupts nervous system	Ovide and generics
Lindane[2]	Disrupts nervous system	Kwell, Thionex

[1]Although there are pyrethroid-based products available over-the-counter, medical professionals still prescribe these. If you know which treatment you prefer explain which and why. Bringing a copy of this document may be helpful.

[2]Widespread head lice resistance has been documented. Medical professionals may not be aware. Bringing a copy of this document may be helpful.

*Benzyl alcohol may be listed as an active ingredient or an excipient additive and is found in some prescription and over-the-counter products. It is highly effective at killing head lice, but the following should be noted: benzyl alcohol is flammable, keep away from open flames. Allergic reaction is very rare but seek emergency medical help if a treatment causes: hives; difficult breathing; swelling of face, lips, tongue, or throat. Benzyl alcohol may cause serious injury if accidentally ingested or used in patients younger than 6 months. Systemic exposure to benzyl alcohol has been associated with serious adverse reactions and death in newborns and low birth-weight infants.

Alternative treatments

- Home remedies, *such as mayonnaise, petroleum jelly, olive oil, tea tree oil, vinegar, or essential oils,* have been shown to make it hard for lice to breathe.
  No evidence suggests it effectively kills all nits or lice.
- **Standard hair conditioner is as effective.**
- **Kill lice mechanically:** hair drying and brushing. Combing and brushing wet hair damages lice. Hair drying injures adults and nymphs.

Non-Prescription treatments for head lice

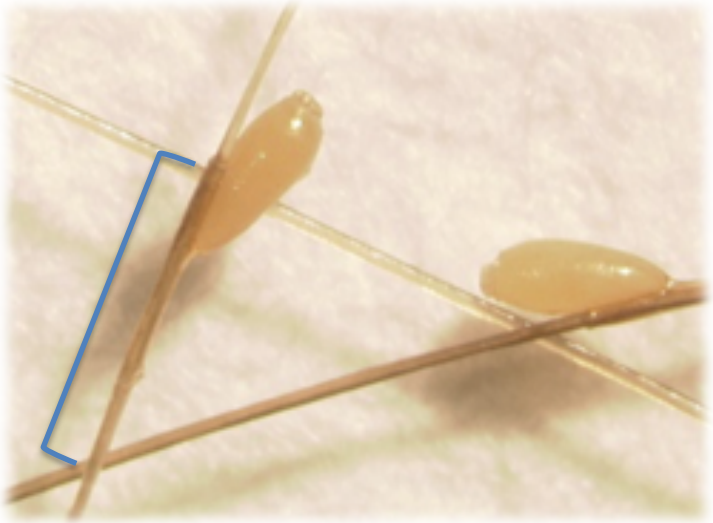
Active or excipient* ingredient or strategy	Mode of action	Product example
Dimethicone (dimeticone)	Disruption of water homeostasis and suffocation	Dimethicone LiceMD gel, Nix Ultra® Solution, Rapunzel's Lice neutralizer, Hedrin Dimeticone Head Lice Lotion, KaPOW! Lice Attack Solution
Natrum muriaticum (sodium chloride) (plus benzyl alcohol*)	Dehydrates or suffocates lice	Vamousse Lice Treatment, Licefreee!
Pyrethroid-based[1]	Disrupts nervous system	Nix, Pronto, Rid, etc.
Enzymes (vegetable extracts)	Helps to dissolve or soften the glue that attaches the nit to the hair shaft	LiceLogic, Lice B Gone, Safe Solutions Lice R Gone®
Heat	Desiccates lice and nits	AirAllé™

[1]Widespread head lice resistance has been documented.

*Benzyl alcohol may be listed as an active ingredient or an excipient additive and is found in some prescription and over-the-counter products. It is highly effective at killing head lice, but the following should be noted: benzyl alcohol is flammable, keep away from open flames. Allergic reaction is very rare but seek emergency medical help if a treatment causes: hives; difficult breathing; swelling of face, lips, tongue, or throat. Benzyl alcohol may cause serious injury if accidentally ingested or used in patients younger than 6 months. Systemic exposure to benzyl alcohol has been associated with serious adverse reactions and death in newborns and low birth-weight infants.

Manual removal

- Manual removal of nits after treatment is recommended.
- Special, fine-toothed “nit combs” are needed.
- Nit combs are designed to loosen the attachment of the nit to the hair shaft.
- Combing is critical to control head lice.
- Check regularly.



Home disinfection

1. Wash items in hot soapy water and dry in a hot dryer for 15 minutes.
2. Launder and dry on a high heat, 130 ^{o}F.
3. Store items in plastic bags for 2 weeks.
4. Vacuum the surfaces where heads may have rested (sofas, helmets, car seats, etc).

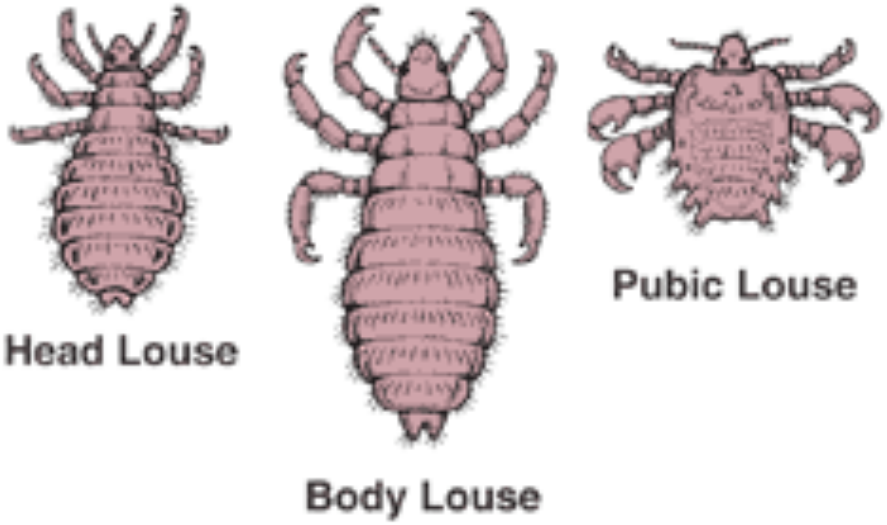
Clothes dryers kill lice

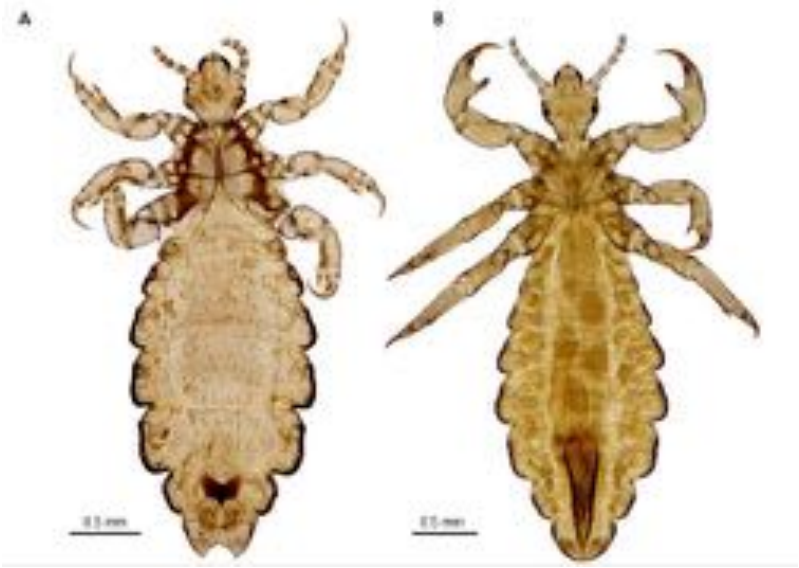
Summary of treatment options

- **<u>Never</u> use gasoline or spray insecticides to treat lice.**
- Work with parents! Routine screening, early detection, accurate ID and thorough removal of lice and nits.
- Chemical treatments
  - A second treatment may be required in 10 to 14 days
  - Resistance may occur
- Alternative treatments
  - Home remedies
  - Standard hair conditioner
  - Kill lice mechanically
- Manual removal – nit combing
- Home disinfection
- Check regularly

Body Lice

A comparison of head, body and crab/pubic lice





Left: Ventral - female head louse;
Right: Ventral - male body louse

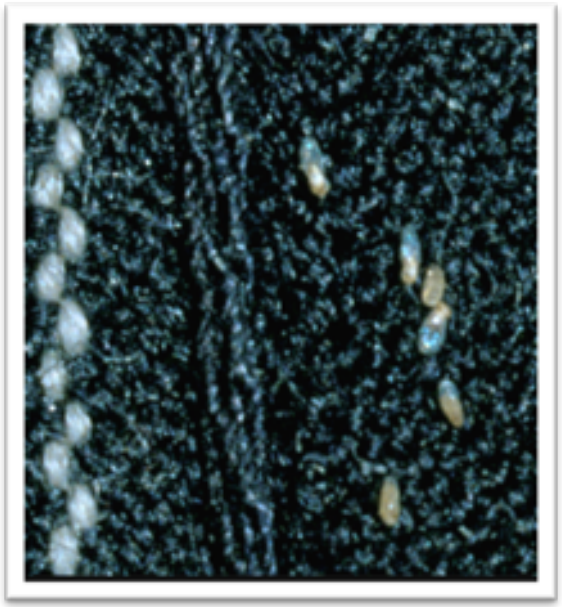
Body lice 2.3-3.6 mm
Head lice 2-3 mm
Pubic lice 1-1.8 mm

Body lice facts

- Transfer occurs through prolonged physical contact with person, clothing, or bedding
- Hygiene improvements and laundering are usually sufficient to resolve infestations

Body lice facts

- If temperature/humidity is high, lice move to the outsides of clothing increasing transfer chance
- Lice can survive several days off the host and nits can be viable for over a week
- Nits (eggs) on clothing



Complications of body lice

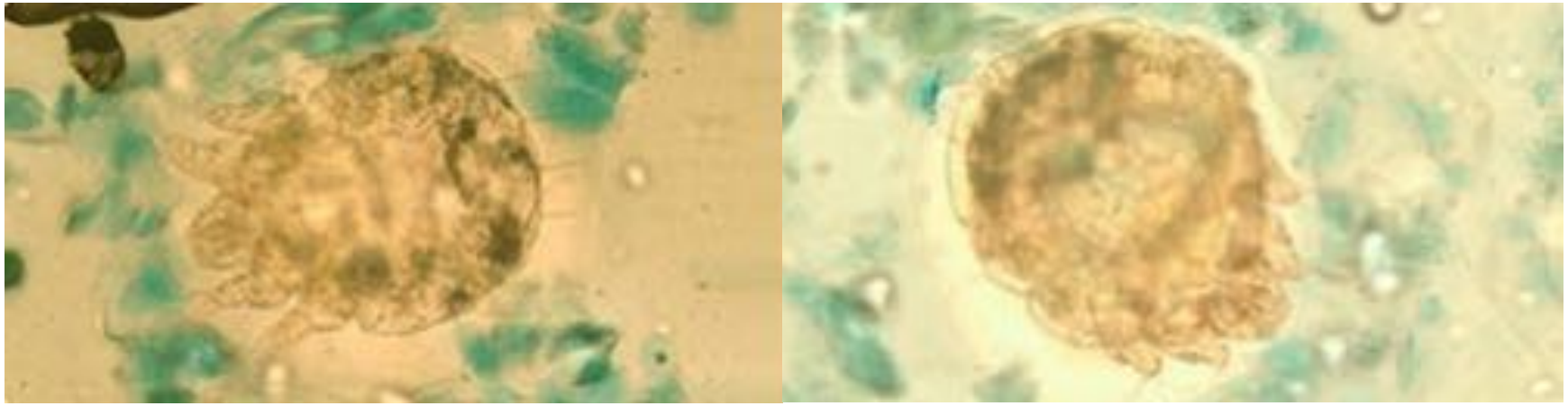
- **Secondary infections.**
  - Severe itching of the skin particularly in hip, groin and upper thigh areas
  - Scratch marks, open sores and healing wounds on the skin
- **Skin changes.**
  - Discolored, rough patches of the skin which may be thickened and hyperpigmented (Vagabond's disease)
- **Spread of disease.**
  - Can carry and spread diseases: typhus, trench fever, relapsing fever

Body lice – a pest you should be aware of in a crisis

- During crisis
  - Avoid sharing bedding or clothing from at-risk community members
- <u>After</u> crisis support
  - Science-based information distributed
  - Clinic, medical center, homeless shelter, school, childcare and eldercare facility support
  - **Free access to personal hygiene facilities and laundering**

Scabies

- Scabies cases increased during the COVID-19 outbreak (Kutlu et al. 2020. *Dermatol Ther*).
- Scabies is an infestation of the skin by the human itch mite (*Sarcoptes scabiei* var. *hominis).*
- Scabies is intensely itching (pruritic); has been called “the worst itch”.



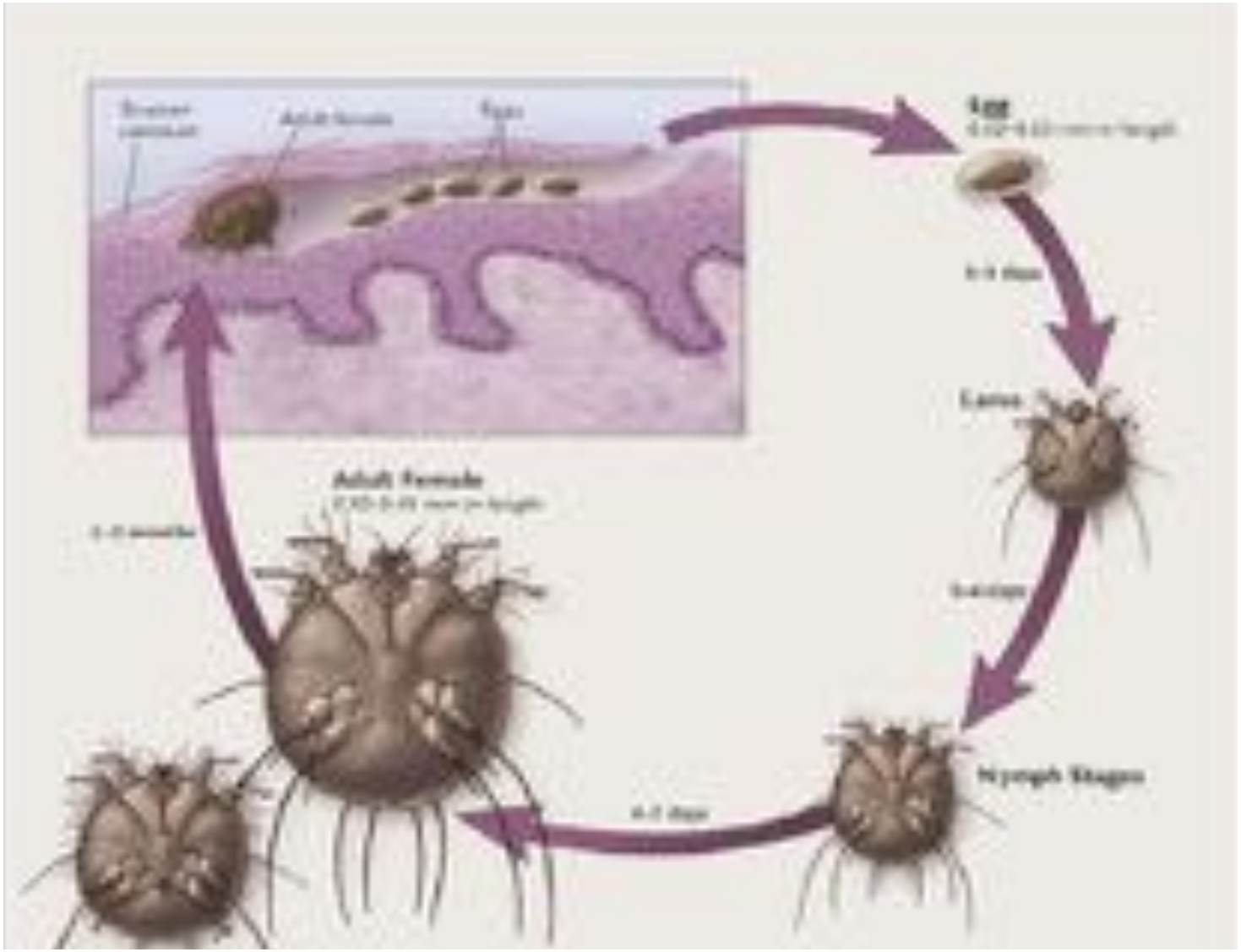
Scabies mite facts

- Female scabies mite burrows into the **upper layer of the skin** where it lives and lays eggs.
- The scabies mite usually spread by direct, **prolonged skin-to-skin contact.**

Mite burrow track

- Optimal environments for the spread of scabies:
  - Crowded living conditions (**lots of people, shared facilities & items**)
  - Medical, childcare, schools and adult daycare facilities (**hands-on care, shared facilities**)

Infestation occurs due to the direct transfer of a single fertilized female mite



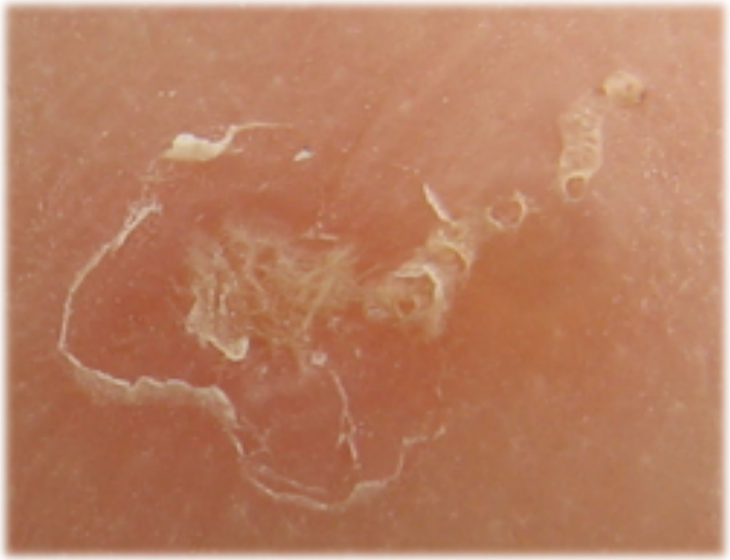
- Adults are 1/3 millimeter long
- Typical infestation – an affected host harbors only 10-15 adult mites
- Moderately contagious. **Pets do not spread human scabies**
- First-time infestation: itching begins 4-8 weeks after exposure
- Symptoms appear 1-4 days after exposure in a person who has had scabies before

How long can scabies mites live?

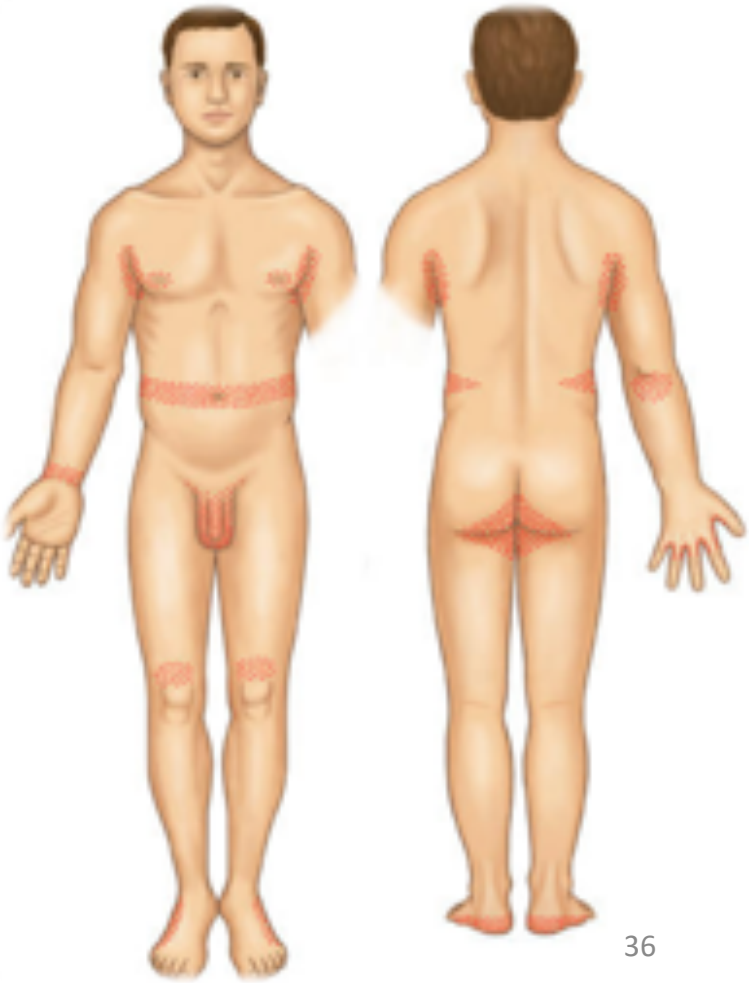
- On person, live for 1-2 months
- Do not survive >2-3 days on inanimate objects
  - Transmission via articles such as clothing, towels, or bedding, is possible, but less likely
- Mites will die if exposed to 50°C (122°F) for 10 minutes
- They are inactive below 20°C (68°F) and can remain viable for longer at 20°C

Signs and symptoms

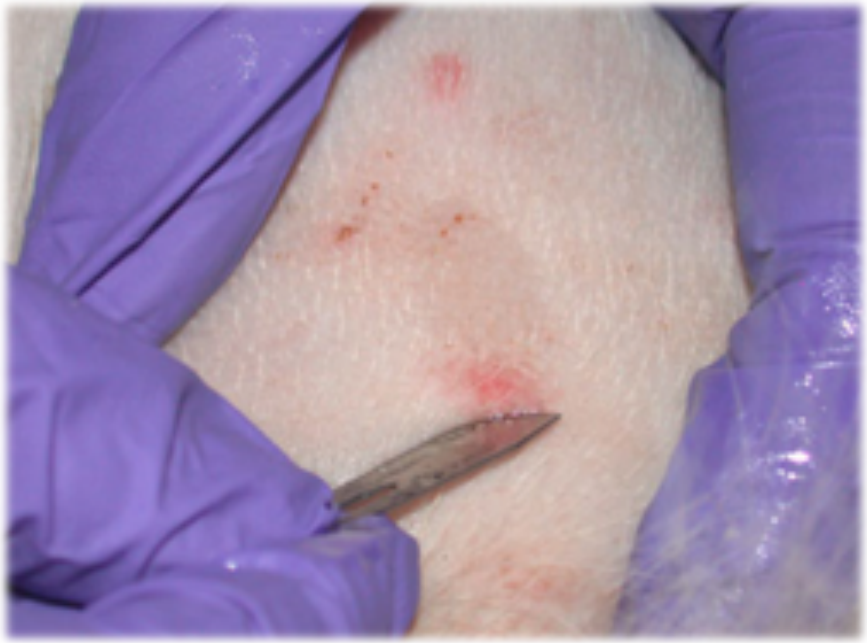
- Disproportionately affects women and children
- **Itching is most severe at night**
- Burrows are often not seen but check in the webbing of fingers or on the inside of wrists
- Malformed fingernails (nails should be clipped short if undergoing treatment)



- **In adults**, rash usually be limited to common sites:
  - The wrist, elbow, armpit, webbing between the fingers, nipple, penis, waist, belt-line, and buttocks
- **Young children can be affected all over their body**
- Secondary bacterial infection may occur



- The diagnosis of scabies should be confirmed by identifying the mite, mite eggs, or mite fecal matter (scybala)
- **Skin scrapes** are the best way to positively identify mites
- An infested person can still be infested even if no mites are found
- However, persons with **crusted scabies should be considered highly contagious**



Crusted (Norwegian) scabies

- A severe form of scabies
- The immunocompromised* people are likely to develop crusted scabies, with thick crusts of skin that contain large numbers of mites and eggs.
- **Very contagious.** Spread the infestation easily both by direct skin-to-skin contact and by contamination of items such as their clothing, bedding, and furniture.

Immunocompromised*: have a weak immune system

Scabies mites – a pest you should consider during and after a crisis

- During crisis
  - Make sure **immunocompromised** people are protected
  - Ensure caregivers have PPE
  - Be aware that *Sarcoptes scabiei* var *canis* can infect vulnerable humans
- After crisis support
  - Science-based information distributed
  - Clinic, medical center, homeless shelter, school, childcare and eldercare facility support

Treatment of scabies mites

- Mites can only be eliminated from a host using **prescription treatments – no resistance**
- Products used to treat scabies are called **scabicides** because they kill scabies mites; some also kill eggs.
- Always follow the instructions and the labels
- Permethrin (e.g. Elimite – 5%) is a neurotoxin that causes paralysis and death of the mites
- It is the most common treatment used today for scabies
- Clean clothes after treatment
- VERY effective

- Crotamiton lotion (e.g. Eurax; Crotan – 10%) frequent treatment failure has been reported with crotamiton – NOT for children
- Sulfur ointment (5-10%)
- **Lindane lotion (1%) is NOT recommended by CDC (and may other authorities), but not all doctors are aware of this**
- Ivermectin (e.g., Stromectol) oral antiparasitic – **not FDA approved** two doses (200µg/kg/dose) taken with food, one week apart

- The antihistamine diphenhydramine (Benadryl), can be useful in helping provide relief from itching
- **Itching often becomes <u>worse</u> after the mites are killed, and can be intense for a few weeks**

Inappropriate things

- OTC pesticides applied to rooms or buses
- Incorrect use of disinfectants applied to room surfaces

Bed Bugs

Bed bugs aboard a nuclear-powered submarine, the U.S.S. Connecticut, in Bremerton (March 30, 2021)

Bed bug facts

Blood feeding true bugs,
Cimex lectularius

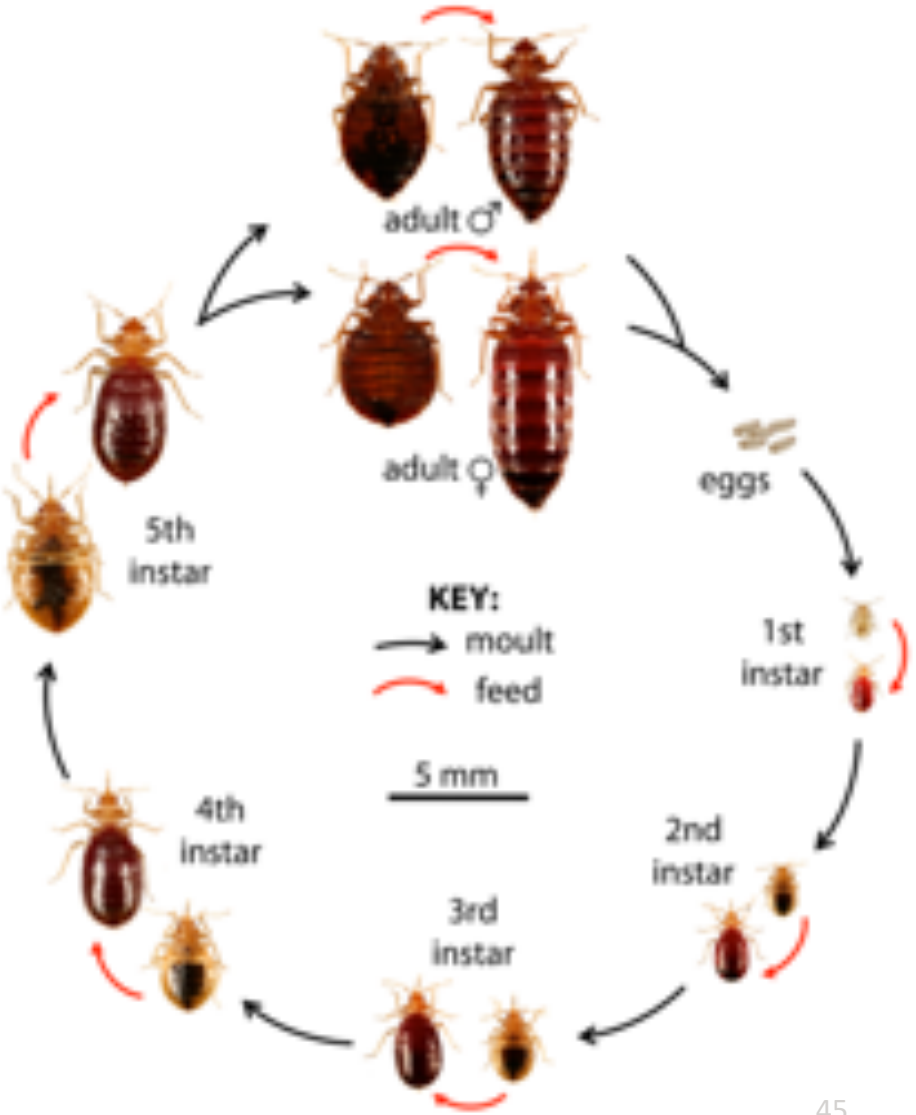
- Order Hemiptera
- Family Cimicidae

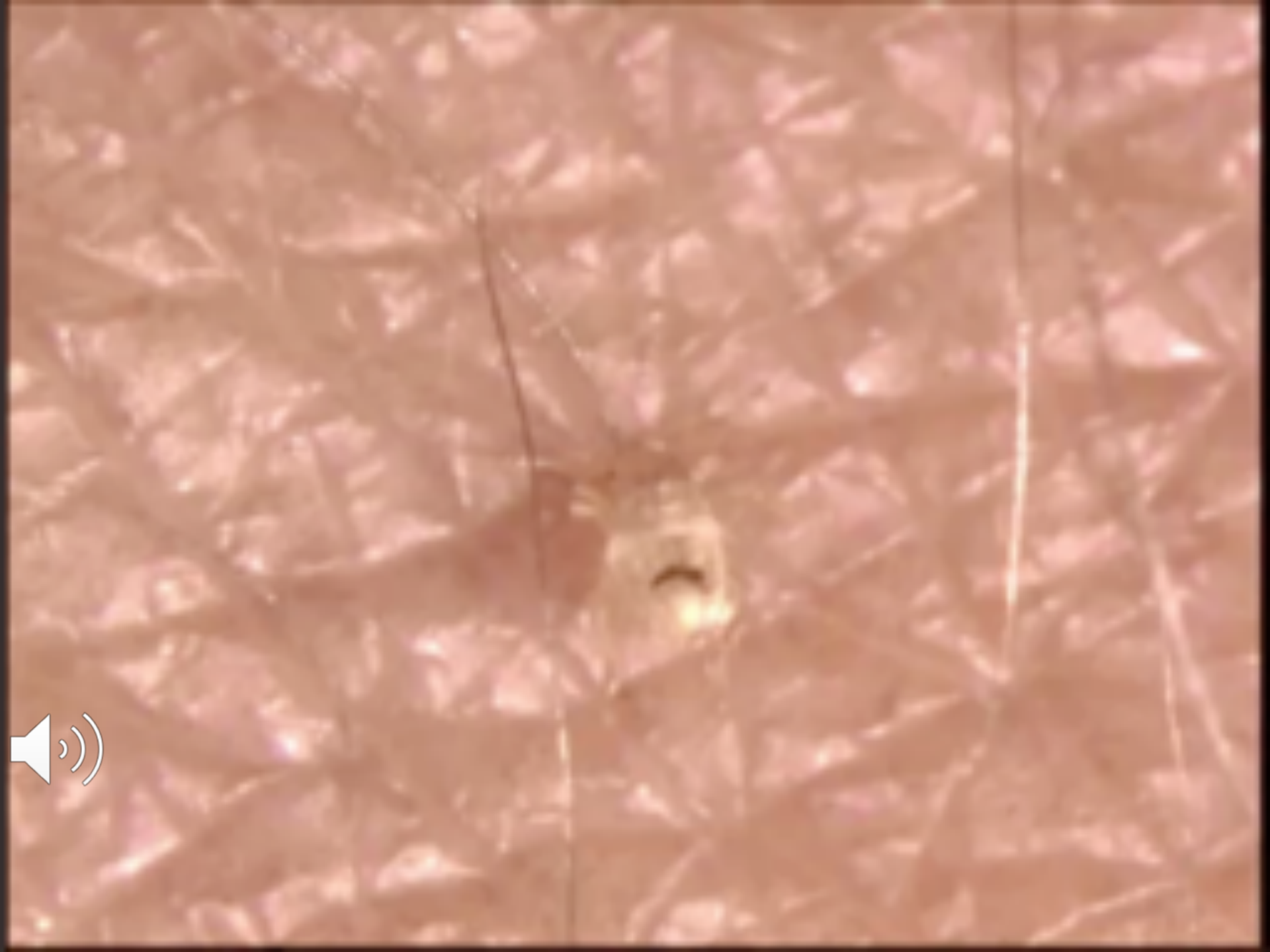
- Small
- Flattened
- Wingless
- Piercing-sucking mouthparts
- Undergoes incomplete metamorphosis

The bed bug life cycle

- Egg
- Nymph (5 stages)
- Adults

Bed bugs need to feed on blood at least once during each life stage after hatching.





7 mm or 1/4 inch

D-H Choe

Adults are about the size of an apple seed

Swallow bug

Bat bug

Bed bug

Cat flea

Apple seed

Cockroach nymph

Chimney swift bug

Shiny spider beetle

Hiding

Active

- Bed bugs feed exclusively on blood.
- Usually feed every 3-7 days.
- Can survive several months without feeding at 70°F (21°C), and can live longer at lower temperatures.
- After feeding, they go back into hiding and move to aggregations in cracks and crevices.

- Digested blood is excreted as black or brown fecal spots.
- Bed bugs detect temperature, CO_2 and other chemicals.
- Stimulated by the increase of CO_2 in the room.

- They engage in traumatic insemination.
- A single mated female can cause an infestation.
- After taking a blood meal females produce 5-20 eggs over ~12 days.
- Females produce ~143 eggs in a lifetime.

- Bed bug development rates are temperature dependent.
- Development is faster in warmer environments and slower in colder environments.
- Development time from egg to adult 31 days at 80°F and 50 days at 70°F.

Bed Bugs and Health Risks

- Itching
- Secondary infection
- Sleeplessness
- Anxiety
- Desperation
- Depression
- Blood loss, anemia
- Disease?

Emotional impact (top 5)

- Loss of sleep
- Cannot relax
- Depression/desperation
- Concerns that they transferred bed bugs other locations

- Loss of self esteem
- Loss of friends & family connections
- Etc.

http://cals.arizona.edu/apmc/public-health-IPM

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
COOPERATIVE EXTENSION
Arizona Pest Management Center

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

Reactions to bites

- Bites <u>may</u> occur in lines - usually on exposed skin.
- Saliva can cause a person to itch and cause swelling.
- Scratching can lead to secondary infections.
- **Adults over 65 years of age tend to react less or <u>not at all.</u>**

- Reactions vary depending on your immune system and number of bites.
- Bites do not confirm bed bug infestations.

Bed bugs are <u>not</u> known as competent vectors but are capable of transferring some in lab studies

Bed bugs – a pest you should plan to deal with after a crisis

- During crisis
  - Don't worry too much, plan to deal with it later
- <u>After</u> crisis support
  - Science-based information distributed
  - Clinic, medical center, housing, homeless shelter, school, childcare and eldercare facility support
  - **Promote monitoring and rapid remediation in homes**

Monitoring traps

12 Volcano Trap

4 Climb Up Interceptors

Bed Bug Beacon

12 Blackout BB Detector

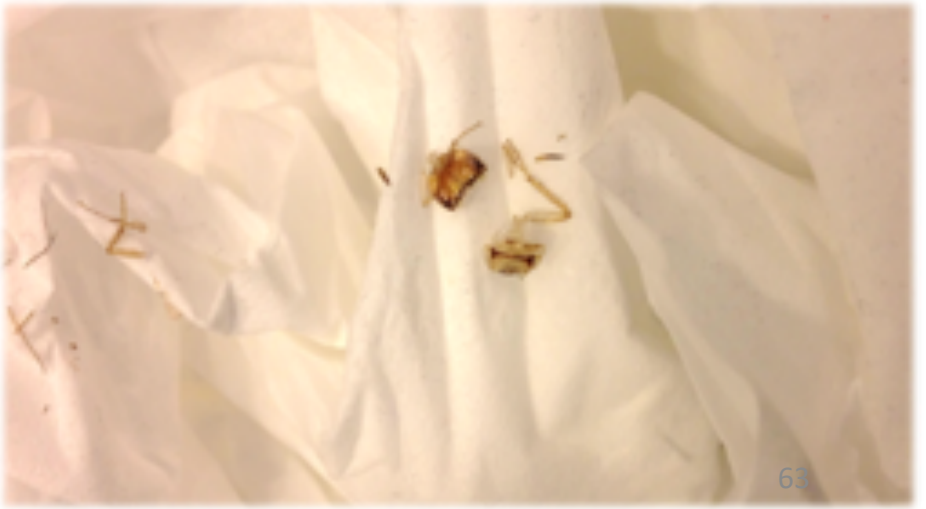
NightWatch

Canine detection

- Excellent detectors
- Can distinguish between live and dead bugs
- Expensive and require constant training
- Are only as good as their handler
- Dog handlers need to keep up with training

Bed bug discovery

- Do not panic or cause panic!
- Carefully collect specimens for identification
- Do not evacuate
- Do not allow people to start spraying or fogging shared space



Management of bed bugs

- Integrated Pest Management (IPM) approach is the most likely strategy to successfully eliminate bed bugs.
- Integrated approaches for management of potentially resistant bed bugs.
- Choose most appropriate treatment options based on:
  - Level of infestation
  - Level of clutter
  - Square footage
  - Customer needs
  - Structure types

Reports of insecticide resistance in “modern” bed bugs

Summary of treatment options

- Vacuuming
- Isolation
  - ✓ Mattresses encasements
  - ✓ Contain/bag infested items
  - ✓ Make the bed an island
- Freezing
  - ✓ Liquid CO_2
  - ✓ Chest freezer
- Heat
  - ✓ Clothes dryer
  - ✓ Steam
  - ✓ Heat container
  - ✓ Whole unit
- Pesticides
  - ✓ Spray (Temprid, Crossfire)
  - ✓ Dust (Alpine, CimeXa)
  - ➢ Rotate pesticides with different mode of action
  - ➢ Use dual-action pesticides

Biopesticide

Aprehend®
Ready to use

Active ingredient	Product name(s)
Imidacloprid + ß-cyfluthrin (neonicotinoid + pyrethroid)	**Temprid® SC Bayer**
Chlorfenapyr (halogenated pyrrole)	**Phantom® PI BASF**
Acetamiprid + bifenthrin (neonicotinoid + pyrethroid)	**Transport® Mikron**
Clothianidin + metofluthrin (PB) (neonicotinoid + pyrethroid)	**Crossfire® MGK**
Thiamethoxam + λ-cyhalothrin (neonicotinoid + pyrethroid)	**Tandem® Syngenta**
Dinotefuran + diatomaceous earth (neonicotinoid + silica dioxide)	**Alpine® Dust BASF** **Alpine® PI BASF**
Imidacloprid + phenothrin (neonicotinoid + pyrethroid)	**Bedlam Plus ® MGK**
Amorphous silica gel	**CimeXa™ Rockwell Labs**

Summary of treatment options

Mattresses – Encasements, Activeguard, vacuuming, cryonite, steam, approved chemical products

Bedding – Launder and dry on high heat

Non-washable clutter items – Hotbox chamber, Nuvan, freezing at -20° C or below >48 hr.

Upper seating surfaces – vacuuming, cryonite, steam, approved chemical products

Carpet – dust products, cryonite, steam

Heat Treatments – follow up AFTER heat with biopesticide Apprehend® around beds and night stands (all surfaces must have cooled to 100° F or less

Green and organic products to control & repel bed bugs, i.e., Freedom Bed Bug Exterminator & Repellent, Eco Defense Bed Bug Sprays, MDX Concepts Bed Bug Killer, Avenger Organics Natural Bed Bug Killer, etc.

Green and organic products to control & repel bed bugs

Examples: Freedom Bed Bug Exterminator & Repellent, Eco Defense Bed Bug Sprays, MDX Concepts Bed Bug Killer, Avenger Organics Natural Bed Bug Killer, etc.

Communicable pests should be anticipated

Thank you!

Drs. Dawn H. Gouge & Alfred J. Fournier, University of Arizona
Dr. Alvaro Romero, New Mexico State University
Dr. Changlu Wang, Rutgers University
Dr. Fang Zhu, Penn State University
Dr. Stephen L. Doggett, University of Sydney

Shujuan (Lucy) Li, Ph.D.
Associate in Extension, Public Health IPM
Arizona Pest Management Center
Department of Entomology
University of Arizona
lucyli@email.arizona.edu