

# CSI: Changing Species Investigation

## *Insecticide-resistant Bedbugs*

This file contains real data about bedbug populations. Is there evidence of natural selection? You're on the case!

### Species Profile

Bedbugs are blood-sucking insects. They hide in bedding and furniture during the day, and sneak out to feed at night. A bedbug bite causes an itchy rash.

Bedbugs were a problem until the 1950s. Then a strong insecticide was invented, and they mostly disappeared. For a long time, "sleep tight, don't let the bedbugs bite" was nothing more than a children's rhyme.

Now bedbugs are back. The insecticide that nearly killed them off isn't used anymore because it's bad for the environment. New, safer insecticides worked at first. But as they're used more, they don't work as well. The ability of a bedbug to survive insecticide toxins is a trait called insecticide resistance (IR).



### Is the IR trait helpful, harmful, or neutral?

Circle the most likely answer for each environment.

1. Before insecticides were invented, the IR trait was (**helpful** / harmful / neutral) to a bedbug.
2. Today with insecticide use, the IR trait is (**helpful** / harmful / neutral) to a bedbug.

### Prediction

Write a sentence about how ***insecticide use*** may affect the ***IR trait*** in bedbug populations:

## Have bedbug populations changed over time?

To find out if IR in bedbugs has changed, you'll compare bedbugs that have been exposed to modern insecticide to those that have not.

Your research team collects bedbugs from cities in Michigan and Ohio where bedbugs have made a comeback. You also have a lab population that was collected from New Jersey 30 years ago. It has never been exposed to modern insecticides. In your notes, you'll refer to each population by where it came from:

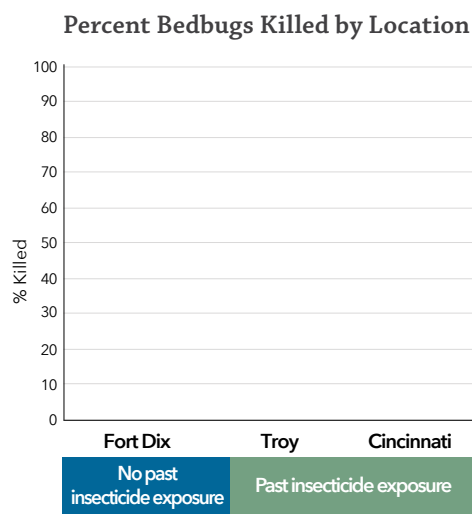
- Fort Dix, New Jersey: no insecticide exposure
- Troy, Michigan: exposed to insecticide
- Cincinnati, Ohio: exposed to insecticide

You applied 1,000 nanograms of insecticide to representatives from each bedbug population, then counted how many bedbugs were killed.

*Let's analyze your data!*

Fill in the table and make a bar graph of your findings.

Bedbug Population	Number Treated	Number Killed	Percent (%) Killed
Fort Dix	60	60	
Troy	60	16	
Cincinnati	60	17	



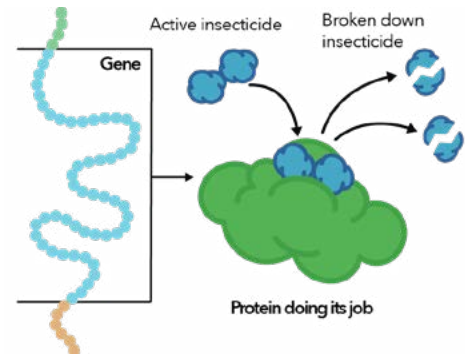
**Summarize the evidence.** Complete the summaries by circling the correct words:

- The IR trait is (**lower / higher**) in exposed bedbugs, compared to non-exposed bedbugs.
- Evidence suggests the IR trait has become (**more common / less common / stayed the same**).
- Does the evidence suggest the IR trait in bedbug populations changed over time from insecticide use? (**yes / no**)

## Is insecticide resistance inherited?

Insects with IR often have proteins that can quickly break down the insecticide, before it has toxic effects. Proteins are coded for by genes, which pass from parents to their offspring.

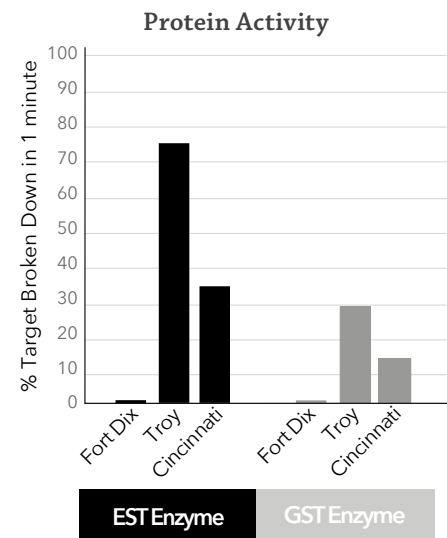
You want to find out if protein differences are causing the IR trait in bedbugs.



From each bedbug population, you collect two proteins: EST and GST. Then, you test each protein's ability to break down insecticide. To do that, you test how much of the protein's target it can break down in 1 minute.

**Summarize the evidence.** Complete the summaries by circling the correct words:

6. Proteins that break down insecticide are **(more active / less active)** in exposed bedbugs, compared to non-exposed bedbugs.
7. The evidence suggests the IR trait is **(heritable / acquired)**.



## Is it natural selection?

Write 2-3 sentences to explain your thinking: