

## WHAT CAN INSECTS TELL US ABOUT CRIMES?

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### YOUNG REVIEWERS:



ERIC

AGE: 11



JASRAH

AGE: 11

Have you ever considered how important insects are in almost all of Earth's ecosystems? Beyond their well-known roles as pollinators, decomposers, and control of other insect pests, did you know that insects can also play a vital role in solving crimes? In this article, we explore fascinating examples of how entomologists (scientists who study insects) can assist law enforcement and the justice system by using insects to crack real criminal cases. By studying the life cycle, ecology, and behavior of insects found at crime scenes, entomologists can provide critical information on the timing and circumstances of a person's death, determine when a food became

contaminated, or figure out how and when a home insect infestation occurred. Prepare to delve into the world of forensic entomology, where you will discover how these tiny creatures contribute to the pursuit of justice.

## INSECTS: BEAUTIFUL AND IMPORTANT

You have undoubtedly encountered **insects** before. Whether on a nature walk or in a bustling city park, you have likely come across bees, flies, butterflies, or beetles in their natural surroundings—hovering near flowers, strolling through the grass, or climbing a fruit tree. Insects, the most abundant and successful terrestrial animals on Earth, thrive in almost every corner of the planet, except for the oceans. While some insects, such as bees, ants, or mosquitoes, can be seen as enemies of humans because of their defensive bites or stings and, in some cases, their role as disease carriers, it is important to recognize their vital roles in maintaining healthy ecosystems.

The specialized field within biology that studies insects is called **entomology**, and the professionals who study this fascinating topic are called entomologists. Entomologists possess extensive knowledge about insects: where they live, how long they live, what they eat, and how long it takes for them to develop from eggs to adults (Figure 1).

### INSECTS

A group of animals with six legs, one pair of antennae and two pairs of wings.

### ENTOMOLOGY

A branch of science that study insects.

### Figure 1

An entomologist observing insects in the field. An entomologist's job is to understand the life of insects, such as where they live, what they eat, or how their behavior can affect humans.



Figure 1

## JUSTICE SYSTEM

A group of organizations that make sure people follow the law.

## FORENSIC ENTOMOLOGY

The study of insects to help solve crimes. "Forensic" means using scientific methods to investigate and solve legal cases.

## INSECTS AS CRIME SCENE CLUES?

Beyond the ecological importance of insects, such as bees pollinating flowers for fruit production, did you know that certain insects can assist detectives and the **justice system** in solving crimes? Thanks to the expertise of entomologists, questions like "how long ago did this murder occur?" or "how long have termites been living in my house?" can be answered. This is called **forensic entomology** [1, 2]. There are real life examples of insects serving as clues in cases of various legal problems, such as understanding who is responsible for food contamination, home infestation, or even understanding how a person died after ingesting a banned substance or poison, among others [3].

## CRIMES INVOLVING HOMES

Consider this scenario: you and your family have moved into a new house, and you excitedly begin to hang a photo on the wall. However, upon inserting the first pin, you discover termites inside the wall, damaging the house's structure. As a result, your family files a lawsuit against the company that sold the house, claiming that it was infested with termites before they bought it. The question that arises is "How long have these termites been living there?". By studying the termites, an entomologist can estimate the colony's age and provide crucial evidence to determine if they were present before or after your family bought the house. This is an example of an urban forensic entomology case, in which insects like beetles, ants, and termites are used to solve these crimes (Figures 2B, C, E).

### Figure 2

Insects that can help forensic entomologists solve crimes include: (A) flies, (B) beetles, (C) ants, (D) moths, (E) termites, and (F) cockroaches.

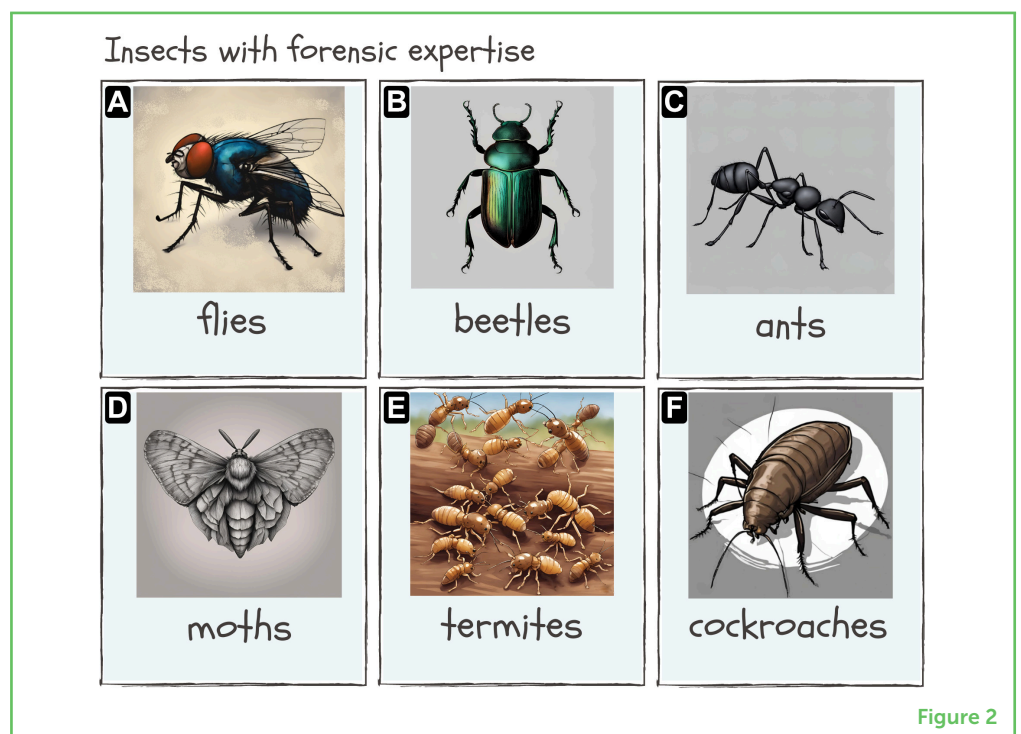


Figure 2

## CONTAMINATION

Presence of impure or harmful entities which can cause consumer illness as well as degrade the quality of food.

## ANIMAL TRAFFICKING

The unethical and illegal transport and sale of animals.

## ISSUES OF FOOD CONTAMINATION

Now imagine you are about to enjoy a delicious chocolate bar. You open the package only to find insect larvae on the candy! How long have these larvae been there? Where did the **contamination** happen? Did the insects get into the chocolate bar at your house, did contamination happen at the market, or was it the result of carelessness by the food manufacturer? An entomologist, after studying morphology, length, weight, and preferential habitat of the insect, along with information about the time between the purchase of the chocolate bar and when the larvae was found can answer such questions. This is an example of a forensic entomology case for stored products or other goods. Flies, beetles, moths, cockroaches, and ants are generally involved (Figures 2A–D, F).

## ILLEGAL ANIMAL SMUGGLING

Now, picture yourself as a police officer working at a major airport. You observe a passenger illegally transporting a box containing numerous insects, which you believe the passenger intends to sell. This is a case of **animal trafficking**, which is illegal around the world. How can you determine where the insects came from if the passenger remains silent? By identifying the insect species and its natural habitat, an entomologist can help gather valuable information about where the smuggled insects came from, and can also reveal whether the insects are an uncommon or rare species, which would make the crime even more serious.

## VIOLENT DEATHS

One of the most studied and well-known areas of forensic entomology focuses on the role insects play in helping experts solve crimes involving violent deaths [4]. In such cases, insects can provide crucial answers to questions like “who is the victim?” or “how long ago did the death occur?” or “where did the homicide take place?”. But how is all this information obtained from insects?

Now picture yourself as a detective called in to solve a crime. When you arrive at the crime scene, you see the victim lying on the ground. As you look closer, you notice some fly maggots around the body. You carefully collect some of the insects to show to an entomologist. The entomologist identifies the species and provides details about life cycle, size, and weight of the larvae you found. Information about the fly’s habitat, for example, can tell you about the location where the murder occurred.



## POST-MORTEM INTERVAL

The time interval between death and discovery of the body.

## NECROPHAGOUS INSECTS

Insects that feed on decomposing animal matter, such as dead corpses.

## LARVAE

The immature form of some insects, such as flies, beetles, ants.

Further, information about the size and weight of the maggots can also provide details about how much time passed between the time the crime was committed and when the body was found, which is known as the **post-mortem interval** (PMI) [4]. Following death, the human body begins a lengthy decomposition process. During this time, the chemical elements present in the skin, bones, nails, and hair, such as carbon and nitrogen, are reabsorbed into the Earth. This decomposition process attracts various species of **necrophagous insects**, drawn by these chemical elements, even from kilometers away! These insects feed on the decomposing matter and lay their eggs or larvae there, continuing their species' life cycle.

For instance, a fly might discover a corpse on which it lays its eggs. These eggs then hatch into **larvae**, which feed and grow. The growing larvae pass through three stages and then seek out a safe (and typically dark) place to enter the next stage of development, known as the pupal stage—similar to the cocoon stage of a butterfly. Eventually, an adult fly eventually emerges from the pupa (Figure 3). This entire process, from egg to adult, takes a specific amount of time for each species, and can be influenced by environmental factors such as temperature and humidity. Therefore, by identifying the type of larvae found on a corpse and studying its size, weight, and structural characteristics, entomologists can estimate the larva's age [5]. This expertise allows entomologists to provide vital information like PMI, in the form of a report that can be submitted as evidence to the court to aid in convicting or acquitting a suspect.

### Figure 3

Some insects go through physical changes in body shape during their life cycles. Most have four stages: (A) adult, (B) egg, (C) larva (which may have several stages called instars), and (D) pupa. The pupa then becomes an adult, restarting the cycle.

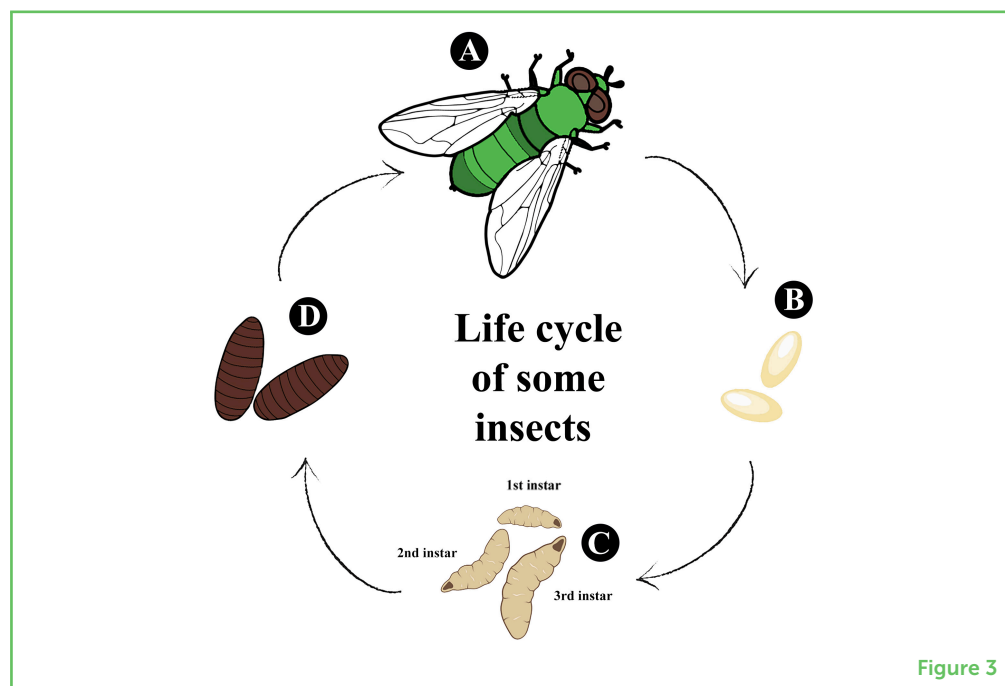


Figure 3

## SEEING BUGS UNDER THE LIGHT OF FORENSICS

Based on what you have learned, you might realize that insects are even more important than you thought! Besides all their critical roles in ecosystems (as pollinators, pest control, decomposition, and in nutrient cycling, for example), some insects can be crucial clues used in solving several types of real crimes. However, the loss of insect populations due to habitat destruction, pesticide use, climate change, and other factors poses significant threats to ecosystem stability and biodiversity. We need to work hard to preserve insect diversity and the essential ecological functions these amazing creatures provide—including crime scene investigation. Remember this cool role of insects the next time you see a bug in nature!

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## YOUNG REVIEWERS

### ERIC, AGE: 11

My name is Eric, and I am Brazilian. I am 11 years old and in the sixth grade at school. I like to run and participate in sports such as swimming, capoeira, football, and biking. I also enjoy playing games, playing the violin, going to the beach, and playing with my cat, Crystal. Additionally, I have an interest in space and robots.



### JASRAH, AGE: 11

Jasrah is a Grade 6 student interested in Biology, Biodiversity, Environmental pollution, and Animals. Her curiosity and desire to learn more about the natural world are evident. She respects the environment and is dedicated to exploring ways to preserve biodiversity and reduce pollution. Jasrah is eager to share her knowledge and insights with others. With her inquisitive mind and commitment to the environment, she is sure to make a positive impact in the years to come.



## AUTHORS

### VINÍCIUS DA COSTA-SILVA

My name is Vinícius and I am a Brazilian scientist. Currently I am working as a postdoctoral researcher at the University of Pretoria (South Africa) and my research focus is beetles. I like to discover and describe new species of beetles. Beetles are amazing! It is really nice to spend time watching what they are doing. When you spend your time admiring nature, you realize how beautiful it is! Besides research, I love to play soccer. Also, I like to read books about crimes. I am a curious person. I think my curiosity about animal life motivated me to become a researcher. [\\*silvavinicius92@gmail.com](mailto:silvavinicius92@gmail.com)



### CARINA MARA DE SOUZA

My name is Carina, I am a Brazilian entomologist very interested in flies. I am very keen on discovering and describing new fly species and understanding how they interact with humans. Fly diversity is astonishing! They have many colors, shapes, many foods and living habits... it is exciting to discover the fly world. Besides science, I teach undergrad students of biology. One of my hobbies is traveling. I really like to travel around my country and around the world, to experience new places, foods,



and cultures. Also, I like to watch movies for relaxing: animation, thrillers, comics, comedy, and dramas, for example.



### **LUIZ ANTONIO LIRA**

I prefer to go by my last name, Lira. I am a Brazilian entomologist with a particular passion for necrophagous beetles. With a Ph.D. in zoology, my career revolves around studying the distribution of these beetle species in different environments and their utility in forensic investigations, especially in cases of violent death. In collaboration with fellow researchers, we successfully estimated the post-mortem interval in a femicide case in Brazil using beetles. Outside of my academic pursuits, I consider myself to be both creative and inquisitive. In my spare time, I enjoy binge-watching crime dramas and indulging in weekend swimming sessions.



### **CATHERINE SOLE**

My name is Catherine, I am a South African entomologist interested in beetles and lacewings, actually I am passionate about anything with six legs. My main interests are related to the disciplines of phylogeography and biogeography; both of these are linked to understanding species' distributions through space and time and the historical processes that have shaped these. I am an avid reader in my spare time—anything I can get my hands on—from scientific papers to fantasy novels. And for more fun and relaxation, I do Pilates.



### **PATRICIA JACQUELINE THYSSEN**

My name is Patricia. I am an associate professor, forensic entomologist, and scientist, currently working at the University of Campinas (UNICAMP) in Brazil. My studies focus on systematics and the development of computational tools to help people identify insects of forensic importance. I am currently coordinating a laboratory at UNICAMP that looks like a giant fly breeding farm. I love flies because they are the most fashionable insects in nature, with their exuberant colors! In my spare time I like to grow flowers and fruit, cook everything, read science fiction and history books, and travel to find new species of flies.