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Learning Corner

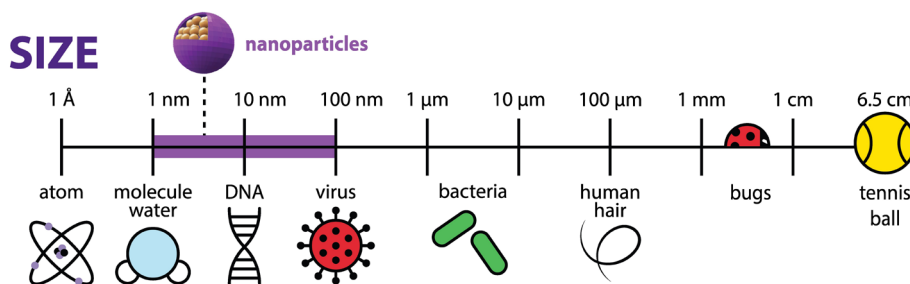
- Nanotechnology in entomology

LEARNING CORNER

Nanotechnology in entomology

Many of us have encountered nanotechnology in popular movies. For instance, in Iron Man 3, Iron Man creates a suit using nanotechnology, and in the 2021 James Bond movie No Time to Die, James Bond tackles a threat from nanobots. Numerous Hollywood films feature references to nanotechnology. A quick online search reveals that 68 recent movies incorporate nanotechnology in their storylines. But what exactly is nanotechnology? And how can it be utilized to drive innovation in agriculture?

Nanotechnology manipulates material between the size range of 1-100 nm (Picture 1). It's hard to wrap one head around what a nano-meter size represents. To get a better "feel for this size," we can think about an example from the Australian Academy of Science: if the whole population were the size of a nanometer, we would all fit in a Hot Wheels matchbox car.



Picture 1. Scale courtesy of Mrs. Crystal Ly showing the size range of nanoparticles.

Nanotechnology is not just about manipulating size; by manipulating size, the properties of the materials are often changed. Essentially, by breaking down the bulk material into smaller sizes, we expose more surfaces, which changes the material's properties. We achieve this not by altering the chemical composition

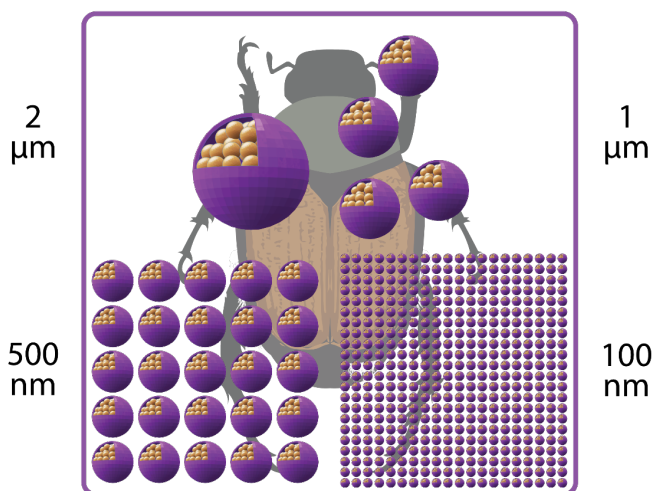
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or crystal structure, but by breaking it into smaller pieces, thereby significantly increasing the volume-to-surface ratio. By changing the material's properties, we can now use nanomaterials in new applications. For example, materials can become more durable, robust, or conductive than their bulk-size counterparts. For example, if we look at gold, in bulk size it is inert, however, by reducing the size to nano-size the color changes to a reddish-purple and it can be used in different applications such as a catalyst, detection of different anions (changes colors due to aggregation), or applications in cancer medicine. An inert substance is now more reactive in different applications, what has changed is the size of the material.

Nanotechnology is already available in commercial products such as sunscreen, clothing, and adhesives.

Applying this to agriculture applications, we can now make materials that have a higher surface-to-volume ratio (Picture 2). The application of nanoparticles is more bio-available to insects or plants. This can result in less active ingredients being used, which can lower the cost of the product. Nanotechnology can also be customized, adding multiple ingredients to the material or changing the size and shape. The material can also have a protective coating that only opens under the right conditions. The technology can be used in a range of applications, foyer sprays, seed treatments, fertilizers, or nutrient delivery.



Picture 2. Drawing Courtesy of Mrs. Crystal Ly. Showing a spray of different particle size and the surface area that the same amount of spray will cover.

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HOME

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