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LEAF CUTTER ANTS

HOW SMALL INSECTS CUT THROUGH A BIG WORLD

THE UNIVERSITY OF OREGON SCIENCE COMICS
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The bite of a wolf can do considerable damage due to their sheer size and strength. But have you ever wondered how an ant can cut the same skin that a wolf struggles to bite through?

Ants are so small and have such tiny muscles that it seems unlikely they could break the same skin as wolves.

The key to a leafcutter ant's cutting ability is that their mandibles are as sharp as a scalpel. Sharp mandibles stay sharp under high pressure because of zinc that is woven into their structure.

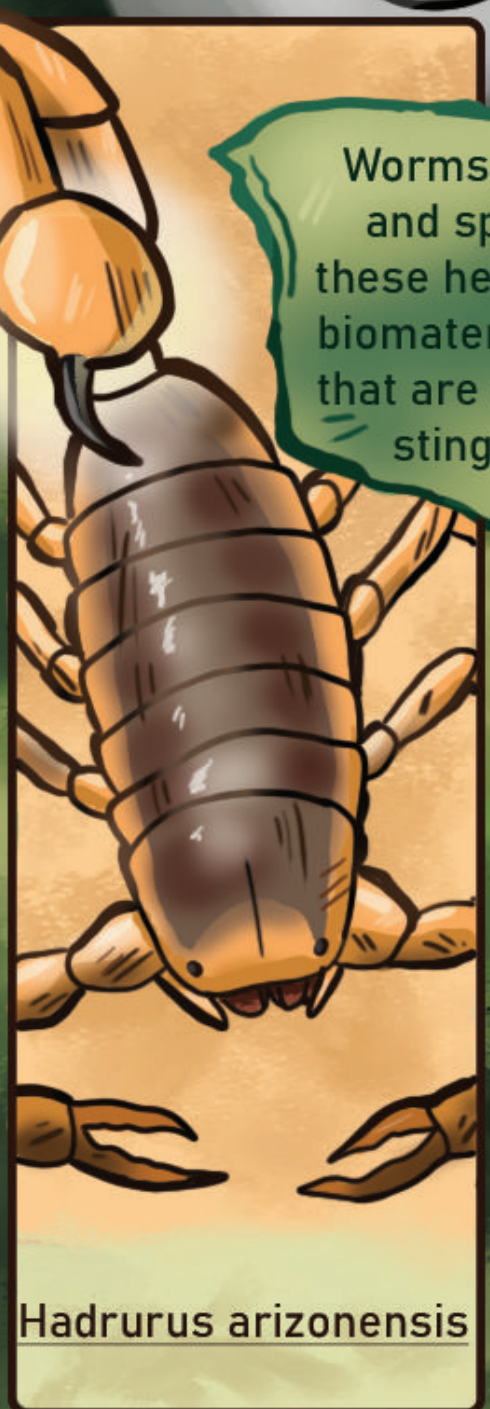
Zinc and manganese infused materials are known as "heavy element biomaterials" and can be found on the sharp tools of other small animals as well.

Mn

Zn

Worms, scorpions, and spiders use these heavy element biomaterials in tools that are used to bite, sting or grab.

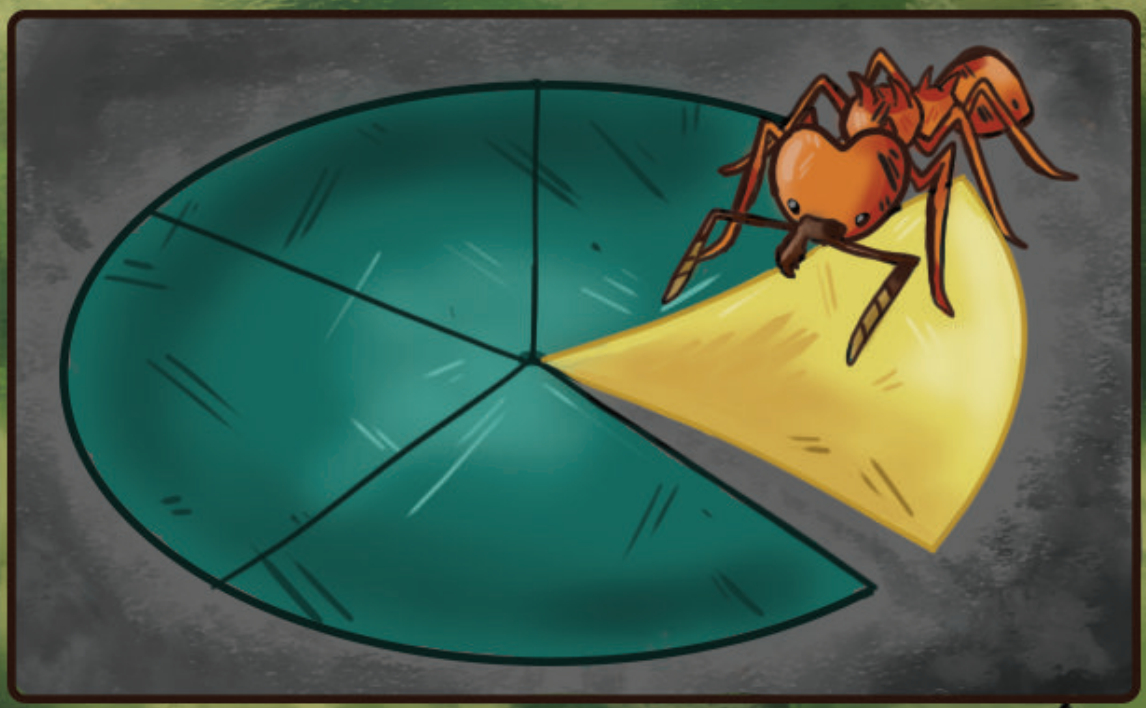
Neanthes brandti



Hadrurus arizonensis

Araneus diadematus

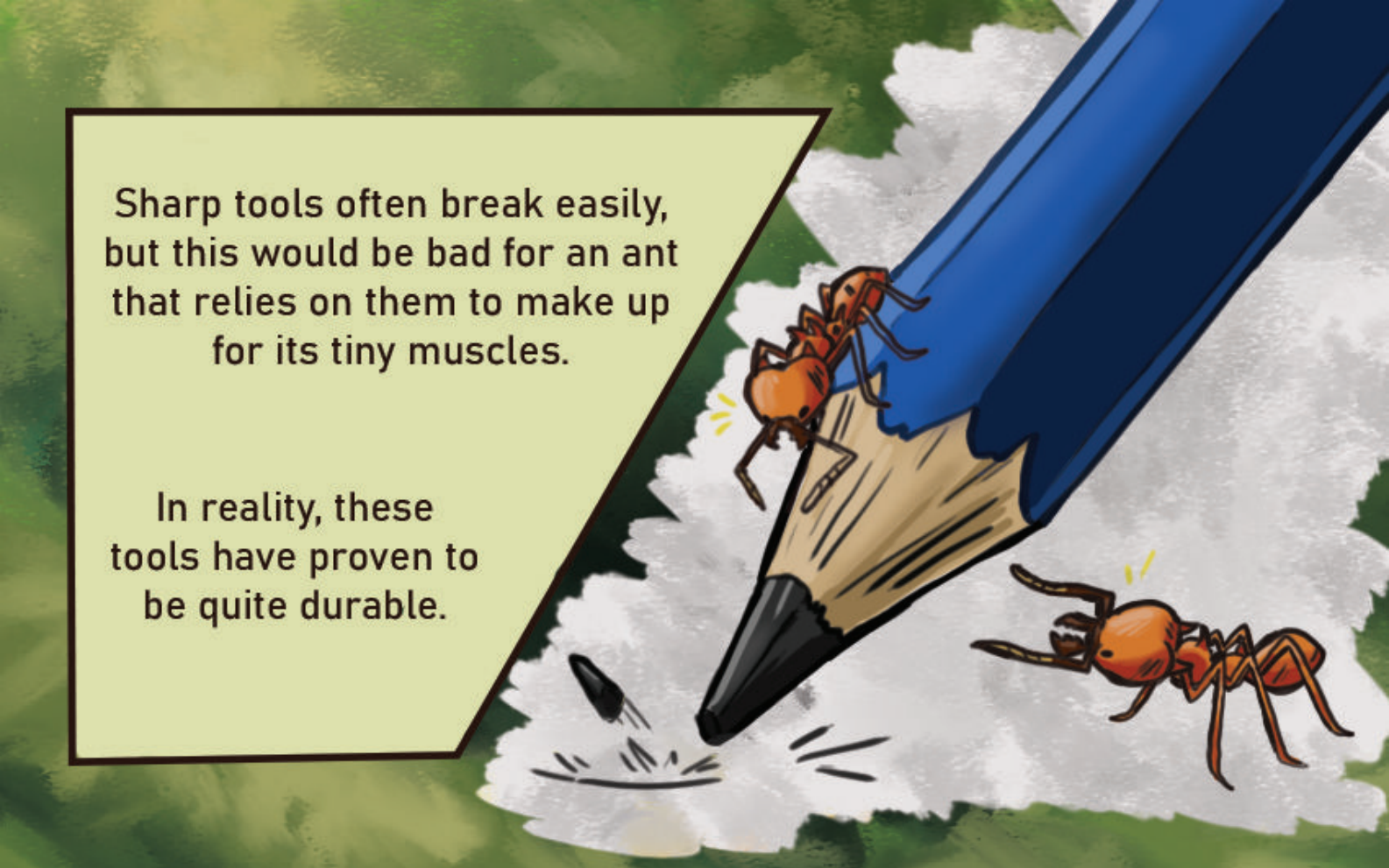
These “heavy element biomaterials” can puncture surfaces using only one fifth of the force of other hard structures grown by these animals.

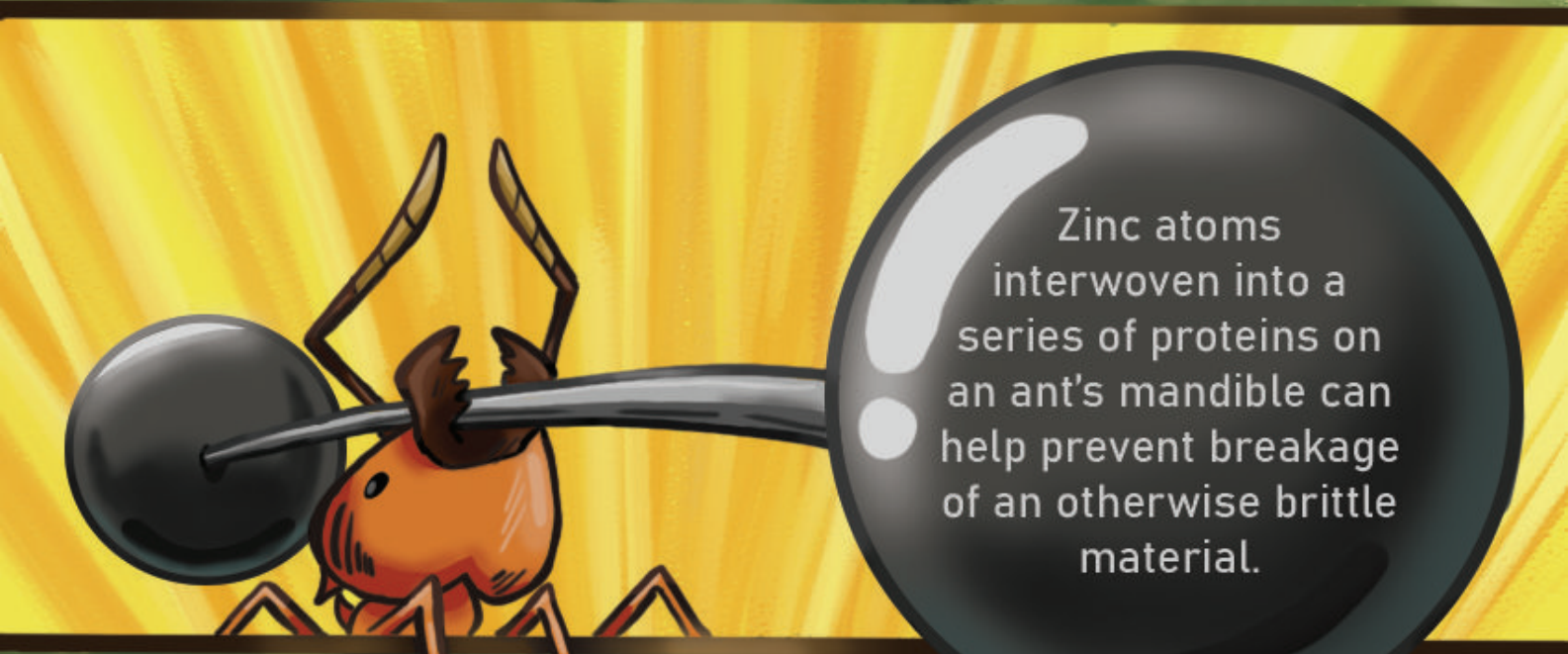


Bigger animals like the wolf rely on large chunks of calcified material in their teeth which are much duller in comparison. Because calcified teeth cannot be as sharp, it may require more than one hundred times as much force to pierce a given substance.

Sharp tools often break easily, but this would be bad for an ant that relies on them to make up for its tiny muscles.

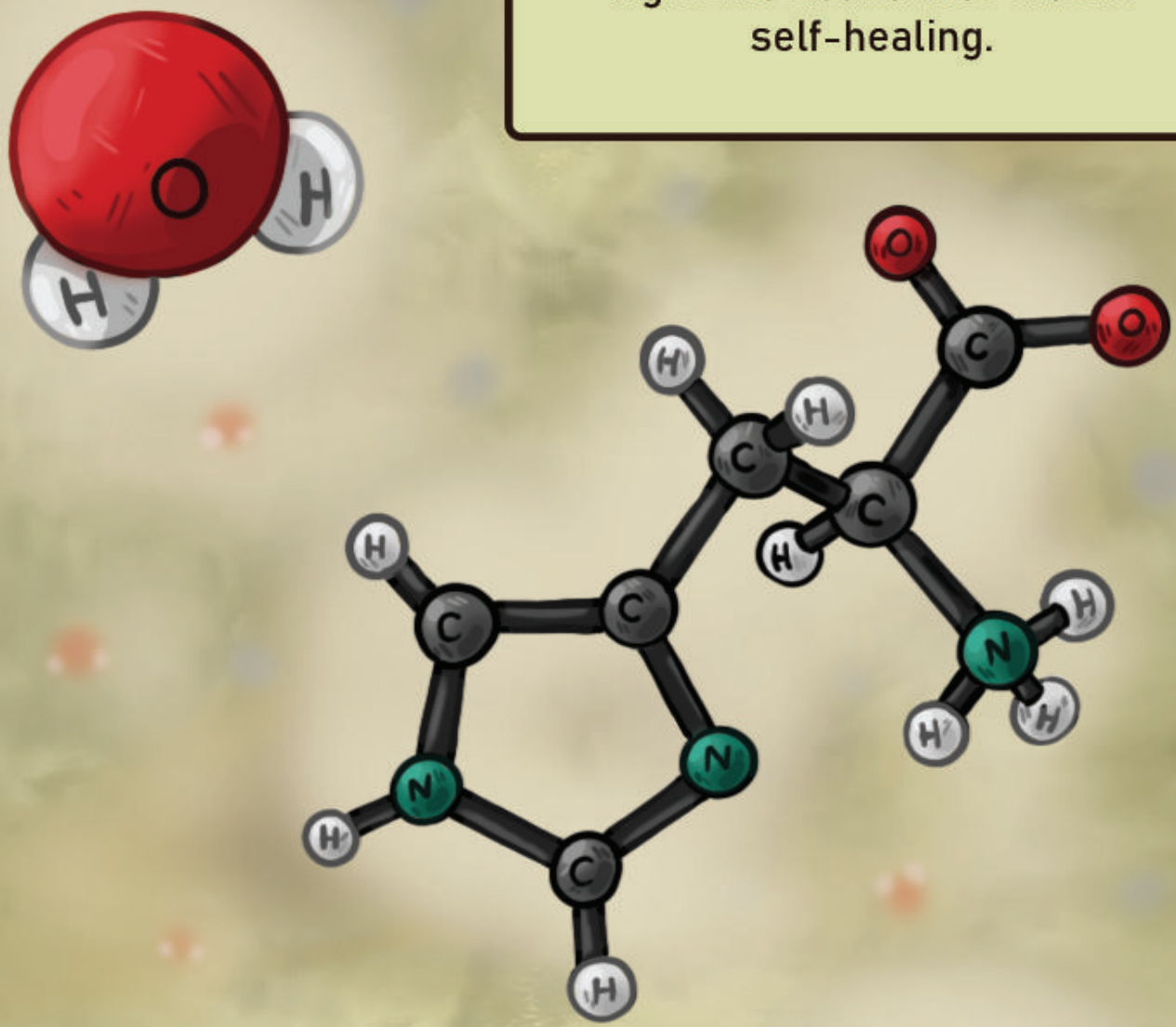
In reality, these tools have proven to be quite durable.





Zinc atoms interwoven into a series of proteins on an ant's mandible can help prevent breakage of an otherwise brittle material.

Surplus amounts of zinc have been detected in tools in the past, leading scientists to believe that high zinc abundance aids in self-healing.



One hypothesis proposes that histidine-zinc-histidine strengthening cross links in the teeth that are broken from impacts or high force can be re-connected with atoms from a nearby reservoir of zinc.

Although heavy biomaterials are durable, they still wear down over the months-long life of a leafcutter ant.

Leafcutter ants spend much of their time cutting leaves, carrying them back to the nest and cutting them into smaller chunks that they grow their fungal food on. All this cutting can dull even wear-resistant mandibles.

When an ant's mandibles become worn, they reach a point where they spend double the amount of time and energy cutting leaves for their colony than a young ant with brand new mandibles.

What does an ant do when its mandibles go dull but it has not yet reached the end of its lifespan? The answer lies in a change in behavior.

Rather than cutting leaves, these ants aid in carrying them back to the colony.

Another job they may take on is defending the colony from potential intruders.

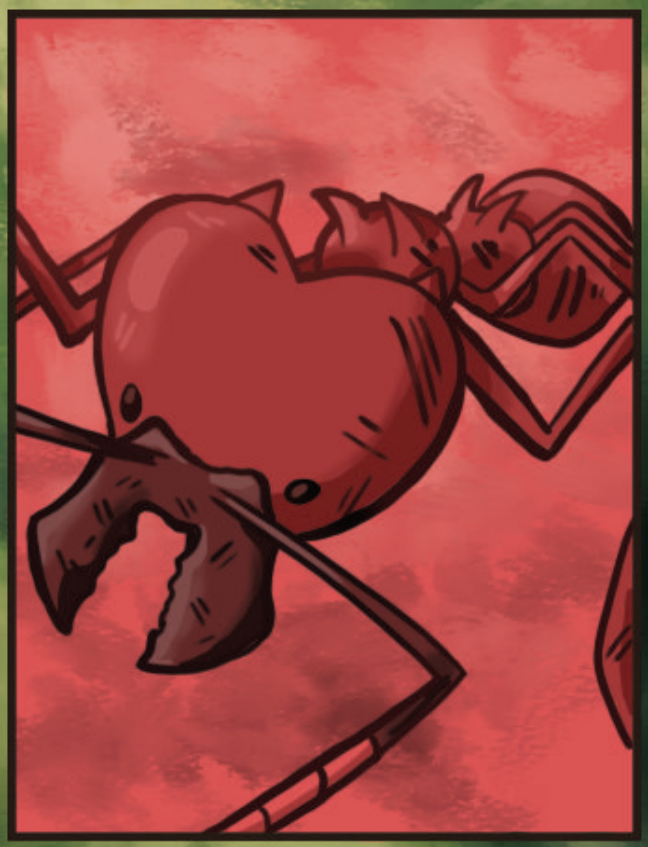
To test how the dullness of an ant's mandibles effect its willingness to fight off intruders, research was conducted using a sub colony of ants extracted from a larger colony originating in Ecuador.

The sub colony was "attacked" with a foam intruder meant to trigger their defenses.

The ants that stayed and bit the foam intruder were dubbed “heroes”.

The ones that ran away however were referred to as “cowards”.

Both the “heroes” and “cowards” were placed into separate groups and analyzed.



The mandibles of both groups were compared. The “heroes” turned out to have significantly duller tools than the cowards with sharper tools. It seems that the ants with sharper mandibles run away because they are too valuable to the colony to risk getting killed. The ants that defend the colony are typically older ants with more worn mandibles who are more expendable.

The wear of a leafcutter ant’s mandibles ultimately changes their behavior overtime. Knowing this gives scientists a better understanding of these insects and can help guide future research.