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Editorial Article

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Mechanisms of Survival of Arthropods in the World

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The phylum Arthropoda is commonly divided into four subphyla of extant forms: Chelicerate (arachnids), Crustacea (crustaceans), Hexapoda (insects and springtails), and Myriapoda (millipedes and centipedes). Arthropods are classified as [Subclass] Apterygial including: Archaeognatha (Order: Microcoryphia), three-pronged bristletails (Order: Thysanura). [Subclass] Pterygota including : Biting and Sucking lice (Order: Phthiraptera), Booklice and Bark lice (Order: Psocoptera) Cockroaches (Order: Blattodea), Dragonflies and Damselflies (Order: Odonata), Earwigs (Order: Dermaptera), Grasshoppers and Crickets (Order: Orthoptera), Praying Mantids (Order: Mantodea), Mayflies (Order: Ephemeroptera), Stick insects and Leaf insects (Order: Phasmatodea), Stoneflies (Order: Plecoptera), Termites (Previously Order: Isoptera but now part of Order: Blattodea), Thrips (Order: Thysanoptera), True Bugs (Order: Hemiptera), Web-spinners (Order: Embioptera), Zorapterans (Order: Zoraptera), Alderflies, Dobsonflies & Fishflies (Order: Megaloptera), Bees, Wasps and Ants (Order: Hymenoptera), Beetles (Order: Coleoptera), Butterflies and Moths (Order: Lepidoptera), Caddisflies (Order: Trichoptera), Fleas (Order: Siphonaptera), Flies (Order: Diptera), Lacewings, Antlions & Mantidflies (Order: Neuroptera), Scorpionflies (Order: Mecoptera), Snakeflies (Order: Raphidioptera), Strepsipterans (Order: Strepsiptera). Over one million species of insects have been discovered and described but it is estimated that there may be as many as 10 million species on earth. Insects have been around for more than 350 million years, longer than the dinosaurs and flowering plants (Figure. 1).

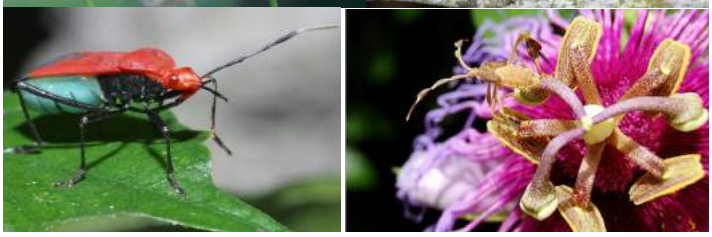
Figure 1: Order of Arthropods in the world

Arthropod in the world have different mechanisms of survival including: escape, repellency, mimicry, camouflage, cuticular barrier to invasion, internal defenses, immune mechanisms. Family of Pentatomidae bugs and Tenebrionidae beetle have repellency smell (Figure. 2). The other mechanism is self-protection including camouflage and mimicry. Mimicry is when insects fool their enemies by looking like an insect that is dangerous or bad tasting. A hornet fly has the markings of a hornet, but has no stinger. Predators who have had their mouths stung by a hornet do not try to eat hornets again, nor do they try to catch the hornet fly. Camouflage looks like things in its environment. Many of insects looks like flower (Figure. 3)

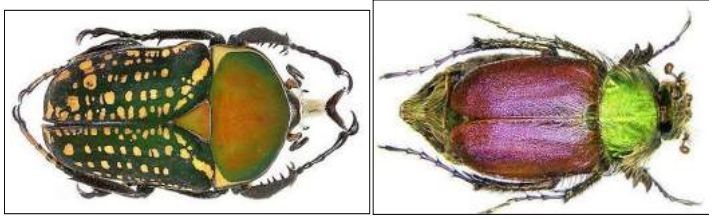
Figure 2: Family of Pentatomidae bugs and Tenebrionidae beetle have repellency smell









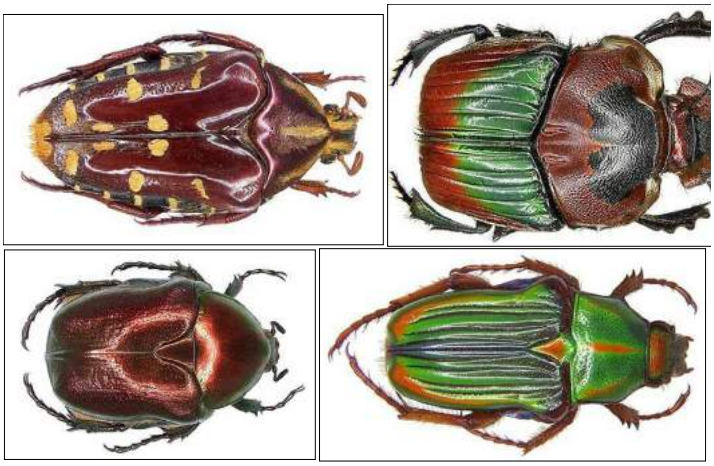


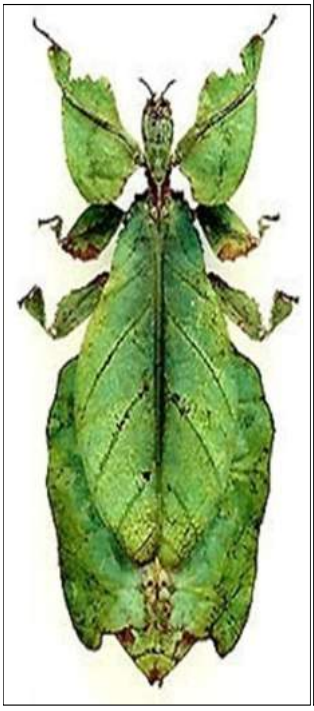
Figure 3: Mimicry of insects look like flowers Some of other arthropods looks like a thorn (Figure 4)

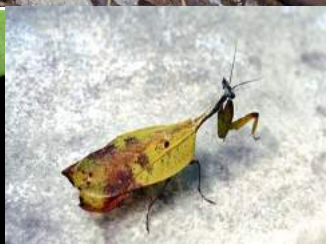
Figure 4: Some of other arthropods looks like a thorn (Figure 3) Some arthropods look like stick (Figure 5)

Figure 5: Some arthropods looks like stick
Some of arthropod looks like leaf (Figure 6)









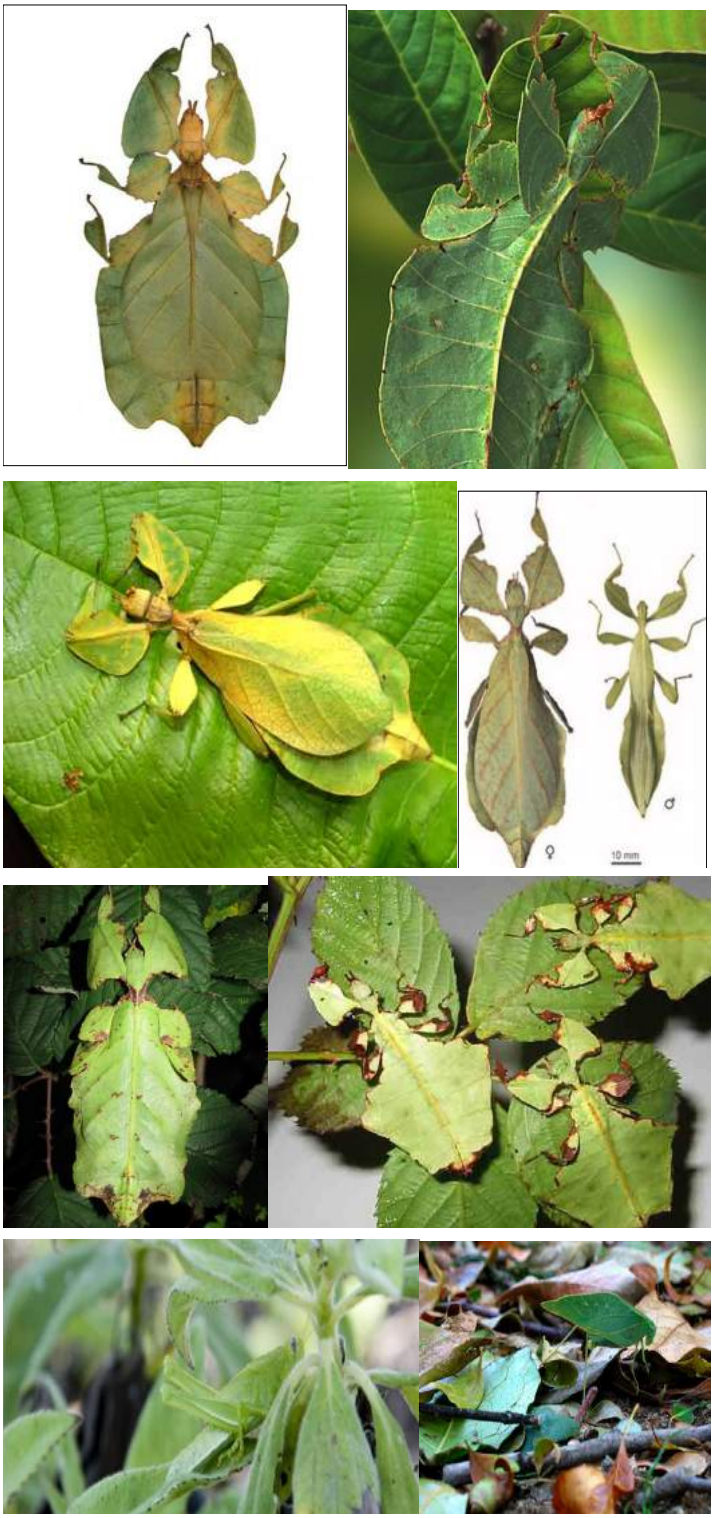


Figure 6: Some of arthropod looks like leaf
Some of arthropod lay eggs like seed (Figure 7)

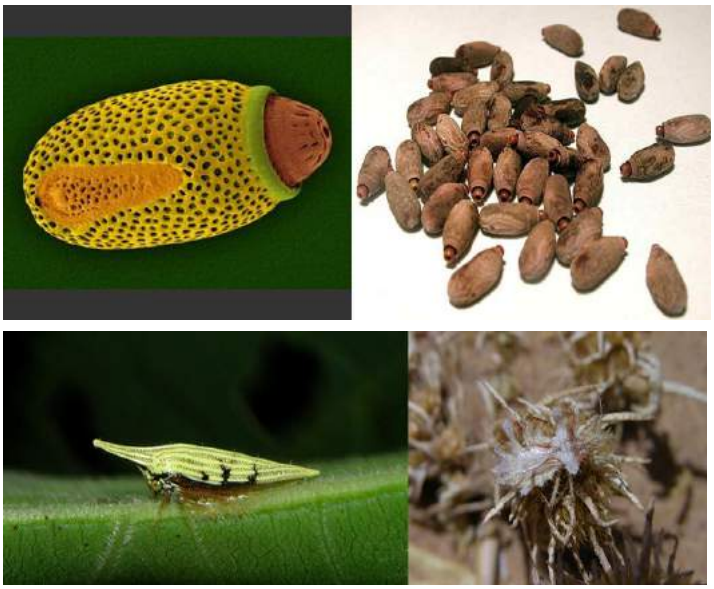


Figure 7: Eggs and adult's arthropods stick looks like the seed of plant

Some arthropods look like the bird dropping (Figure 8)

Figure 8: Some arthropods looks like the bird dropping

Some of the arthropods looks like the environment which are living (Fig 9).

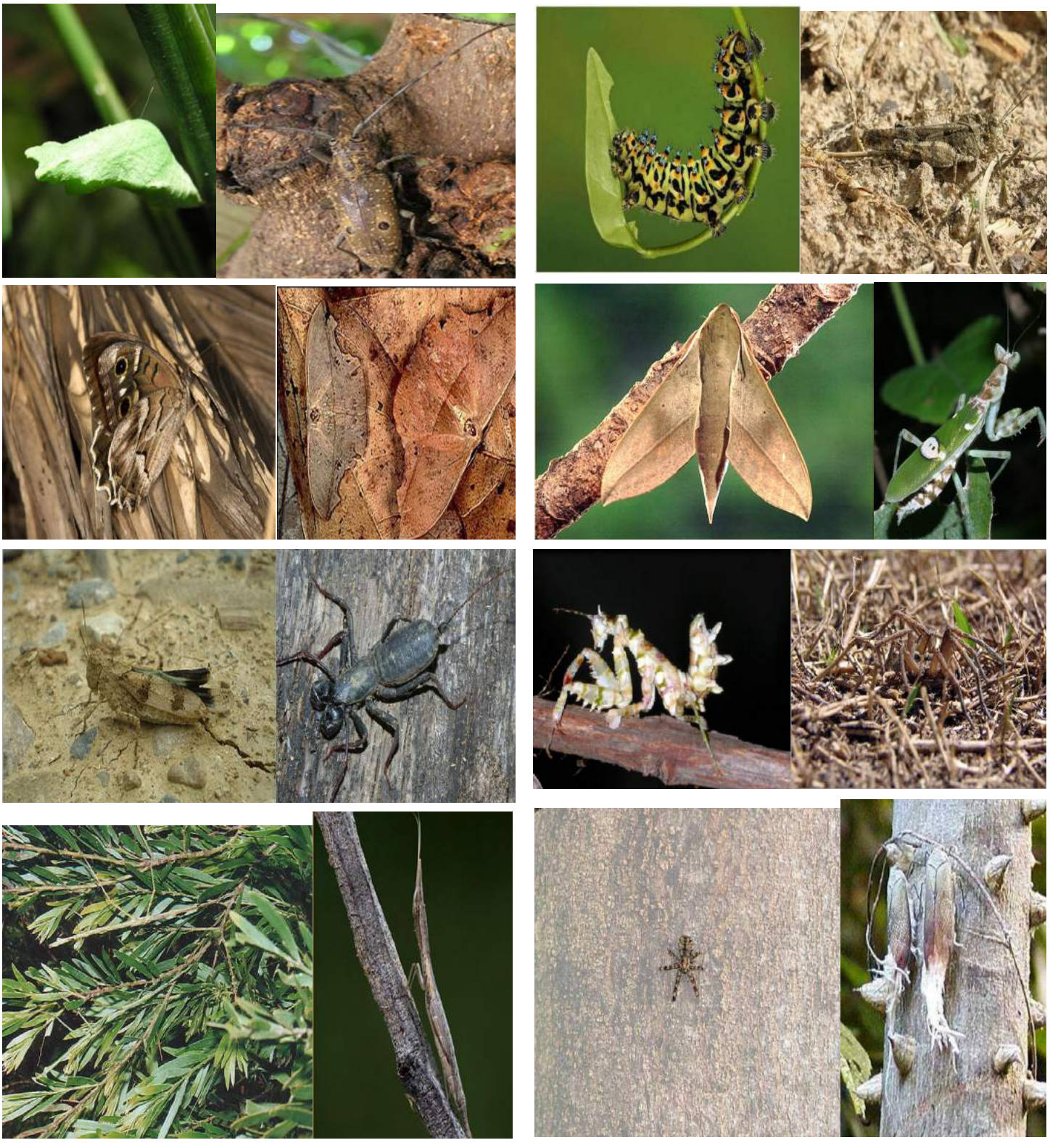


Figure 9: Some of the arthropods looks like the environment which are living

Mimicry

Some arthropods mimic the other arthropods. Beetle larvae that cooperate to mimic bees. Typical aggregation of parasitic blister beetle larvae (*Meloe franciscanus*), on a grass blade, presumably waiting for a male bee to approach. All the larvae have the smell of bee. Male bee approach for mating, after that all the larvae goes on the body of male and then they go in to the home of bees to take honey and food (Figure.10).

Figure 10: Typical aggregation of parasitic blister beetle larvae (*Meloe franciscanus*), on a grass blade

Some of larvae of insect looks like snake for their protection from enemies (Figure 11)

Figure 11: Snake-head caterpillars (different species)

In some insect there are the eyes of owl on the wings to prevent the capture by hawks and other enemies (Figure 12)

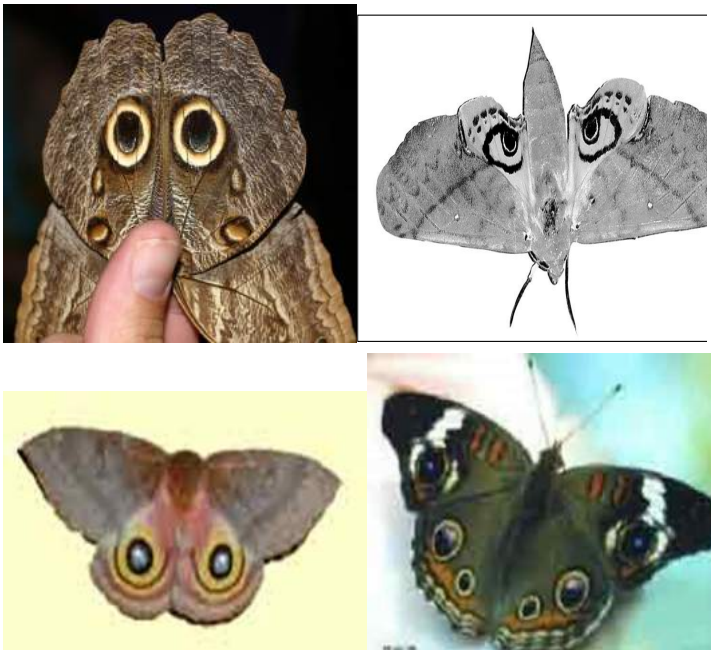
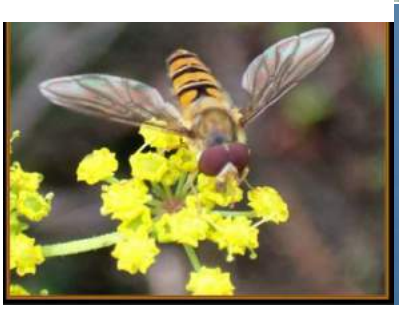


Figure 13: eyes of owl on the wings to prevent the capture by hawks and other enemies

Some of non-poisonous insect mimic the poisons wasp to prevent from damage by the enemies (Figure 14)



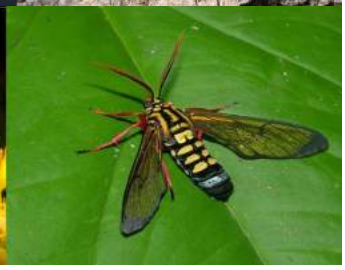


Figure 14: Some of non-poisonous insect mimic the poisons wasp to prevent from damage by the enemies

some butterflies such as *Attacus atlas* cahnge their wing to the snake shape to prevent hungin by the birds (Figure 15)

Figure 15: *Attacus atlas* change their wing to the snake shape to prevent hunting by the birds and other enemies

Some beetles when approaches by the enemies, they lay down and resemble to be died and have the smell of dead body (Figure 16)

Figure 16: Some beetles when approaches by the enemies, they lay down and resemble to be died and have the smell of dead body. This desert ironclad beetle is playing dead

Self-mimicry: some insects produce the eyes at the end of body for confusing the predators (Figure 17)

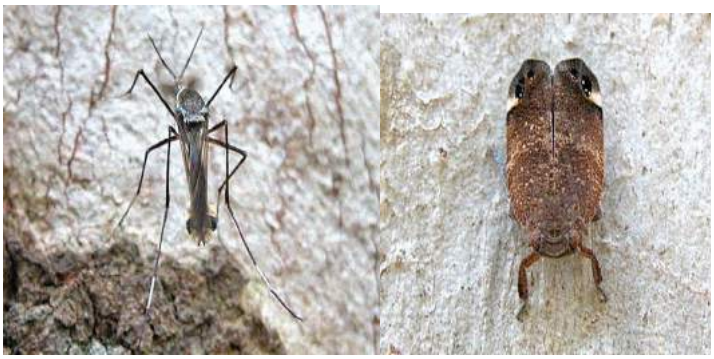


Figure 17: Some insects produce the eyes at the end of body for confusing the predators

Some butterflies mimic the colors of the bad tasting butterflies to trick predators. The Texas State Butterfly, the Monarch tastes bad to birds and lizards. Another butterfly called the Viceroy is adapted to mimic the Monarch so predators won't eat it (Figure.18).

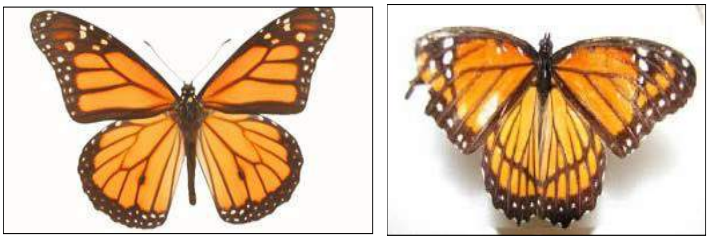


Figure 18: Monarch Butterfly as a pattern for Viceroy Butterfly

Some Mecoptera family mimic the scorpion for prevention of damage by the enemies (Figure.18)

Figure 19: Some Mecoptera family mimic the scorpion for prevention of damage by the enemies

An insect is able to resist the development of disease after entering microorganism in to hemocel; Such resistance is associated with: Cellular response and acellular (humeral) response. Insect hemolymph consists two parts including: Fluid protein (Plasma), which contain, 90% water, inorganic ions such as. Na+, Ca++, K+, etc., nitrogenous wastes, carbohydrates (alpha-treehouse, glycerol), lipids, free amino acids, proteins and enzymes, pigments, hormones, and Blood cells (hemolytic). Blood (haemolymph) is around 10-40% volume of insect's body. Functions of hemolymph is: lubricant, hydraulic medium, hemostatic pressure, breaking out of pupation, spreading wings at last molt, reflex bleeding (blister beetles and lady birds), transport medium (nutrients, hormones and wastes), storage-amino acids, protection-reflex bleeding (Figures 20,21). Humoral defense mechanism and antimicrobial peptides and proteins including: cecropins, attacins, defensins, lysozymes, lectins sarcotonin, rosomysin, sepecin, acaloleptin, coleoptericin, holotricin, hymenoptaecin, royalisin, apidaecin, andropin, tachyplesin, polyphemusin, magainin, hemolin, diptericin.

Figure 20: Breaking out of pupation

Figure 21: Reflex bleeding as mechanism of resistant to enemies

Insect hemolytic originate from mesodermally derived stem cells. Cell secrete certain humeral factors. Humeral factors are involved in cellular activities such as: Phagocytosis, Encapsulation. Cellular immunity is mainly involved with blood cells (haemocytes). The process of cell multiplication and differentiation is called Hemopoiesis (Figure. 22). Haemocytes are complex of several types of cell circulate within the lymph. Haemocytes sometimes attached to other tissues. Haemocytes do not transport oxygen, they are nucleate cells. Insect Hemocytes form are amoeboid, polymorphic, resemble to the leucocytes of vertebrates. Origion, development, multiplication, morphology, function of insect hemocyte completely differ than vertebrate leucocyte. There are no hemocyte comparable to the vertebrate erythrocytes. Hemocytes have been studied in 200 species in order of Lepidoptera, Hymenoptera, Coleoptera and Diptera. The function of hemocytes are: Blood coagulation, Phagocytosis, Encapsulation, Detoxification, Storage of nutritive materials, distribution of nutritive materials, formation of giant cells, nodules, tumor, encapsulation (recognition of foreignness), coagulation and wound healing, bacteriocidins. There are different homocytes in insects (Figure. 23)

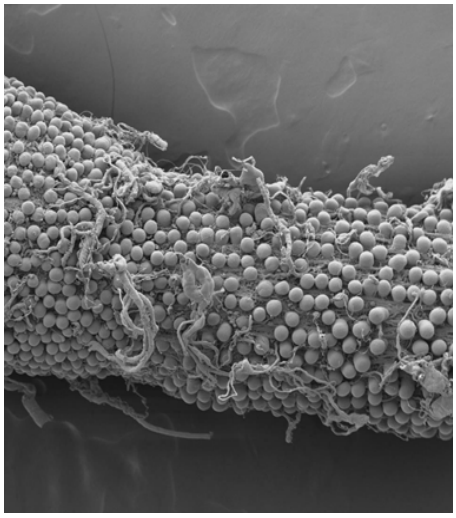


Figure 22: Hemocytes around the beetle gut

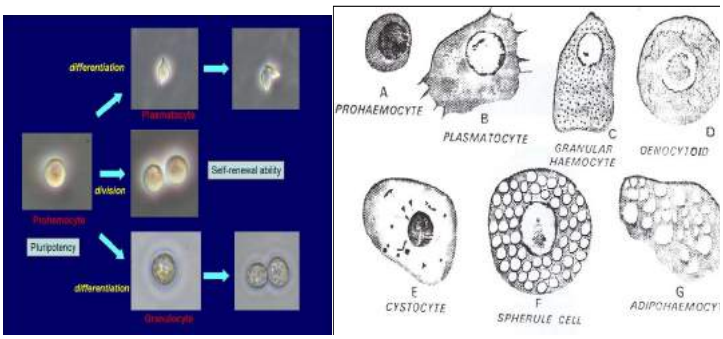


Figure 23: Differentiation of hemocytes in arthropods

In the plant there are different which inhibit the growth of microorganisms such as: terpenoids, phenols, flavonoids, tannins, caffeic acid, gossypol, caryophyllene, Gallic acid. Arthropods used these material for protection against microorganisms [1-5].

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