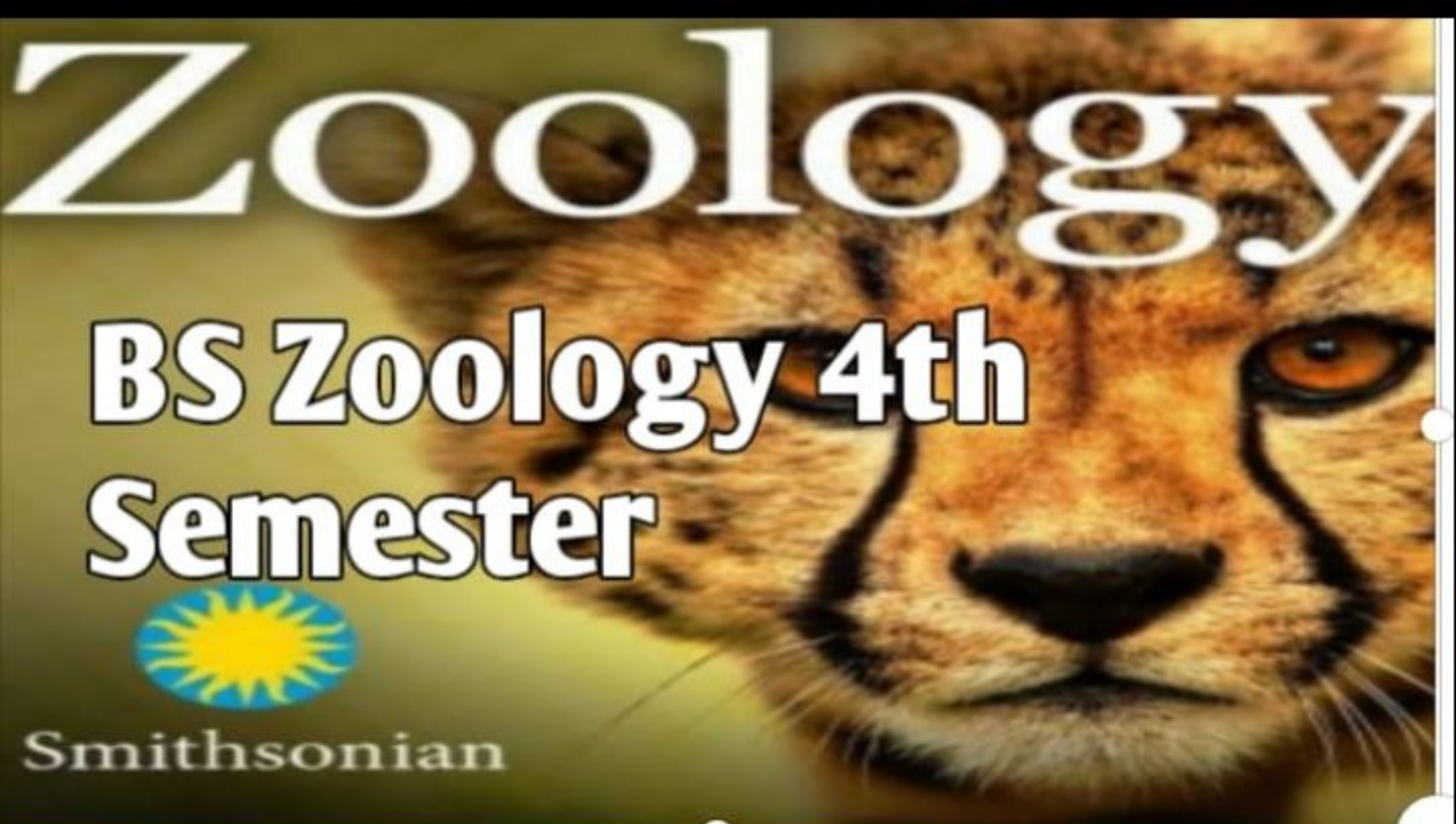


Zoology

A close-up photograph of a lion's face, showing its eyes, nose, and mouth. The lion has a golden-brown coat with dark stripes. The image is used as a background for the top half of the cover.

BS Zoology 4th Semester



Smithsonian

**Prepared & Composed
by Muhammad Habib**

Contact At: 0307 8576495

**The key to success is to focus our conscious mind on things
we desire not things we fear.**

Question # 1 of 10 (Start time: 07:10:16 AM, 02 March 2022)

Total Marks: 1

Larva of sea star is called _____.

Select the correct option

 Reload Math Equations

☒	Bipinnaria
☐	Pupa
☐	Chrysalis
☐	Nymphs

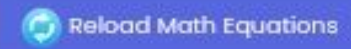
Click to Save Answer & Move to Next Question

Question # 2 of 10 (start time: 07:10:42 AM, 02 March 2022)

Total Marks: 1

Each kind of individual in an insect colony is called a _____.

Select the correct option

 Reload Math Equations

☐	clone
☐	member
☐	epitome
☒	Caste

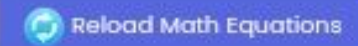
[Click to Save Answer & Move to Next Question](#)

Question # 3 of 10 (start time: 07:11:07 AM, 02 March 2022)

Total Marks: 1

Complete metamorphosis consists of how many stages?

Select the correct option

 Reload Math Equations

☐	2
☐	1
☐	3
☒	4

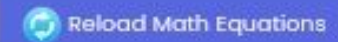
Click to Save Answer & Move to Next Question

Question # 4 of 10 (Start time: 07:11:51 AM, 02 March 2022)

Total Marks: 1

Which of the following shows ametabolous metamorphosis?

Select the correct option

 Reload Math Equations

☐	Butterfly
☐	Moth
☒	Silverfish
☐	Cockroach

Click to Save Answer & Move to Next Question

Question # 5 of 10 (start time: 07:12:14 AM, 02 March 2022)

Total Marks: 1

A tube foot often has a _____ at its distal end.

Select the correct option



Reload Math Equations

☐	hook
☒	suction cup
☐	canal system
☐	madriporites

Click to Save Answer & Move to Next Question

Question # 6 of 10 (start time: 07:12:39 AM, 02 March 2022)

Total Marks: 1

In holometabolous metamorphosis, final process of emergence of adult from cocoon is called _____.

Select the correct option

 Reload Math Equations

- | | |
|----------------------------------|---------------|
| ☐ | Unfolding |
| ☐ | Ecdysis |
| ☒ | Eclosion |
| ☐ | Metamorphosis |

[Click to Save Answer & Move to Next Question](#)

Question # 9 of 10 (start time: 07:13:40 AM, 02 March 2022)

Total Marks: 1

Immature stages in hemimetabolous metamorphosis are called _____.

Select the correct option



Reload Math Equations

☐	Caterpillar
☐	Nymphs
☒	Naiads
☐	Pupa

Click to Save Answer & Move to Next Question

Question # 10 of 10 (**Start time: 06:46:01 AM, 02 March 2022**)

Which one of the following structure plays role in gas exchange in star fish?

Select the correct option

☐	Ossicles
☐	Pedicellariae
☒	Dermal branchiae
☐	Canal system

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 8 of 10 (**Start time: 06:45:37 AM, 02 March 2022**)

Which one of the following control the caste system in honey bees

Select the correct option

☐	Behavior of worker bees
☐	Division of labour
☐	Reproductive potential
☒	A pheromone



8 photos

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REPLY

MARK AS READ

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 7 of 10 (**Start time: 06:45:31 AM, 02 March 2022**)

An insect that transmits a disease is called _____.

Select the correct option

☐	host
☐	parasite
☐	infection
☒	vector



BC200202433: ASMA ZAHEER ABBASI

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 4 of 10 (**Start time: 06:44:44 AM, 02 March 2022**)

_____ make up the class Asteroidea.

Select the correct option

☐	Jelly fish
☐	Feather star
☒	star fish
☐	Silver fish



BS Zoology 4th Semester · now

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REPLY

MARK AS READ

Question 9 of 10 (Start time: 08:46:55 AM, 02 March 2022)

In insects that display ametabolous metamorphosis, the primary differences between adults and larvae are _____

Select the correct option

☐ Shape, respiration☐ Shape, size☒ Body size, sexual maturity☐ Symmetry, reproduction

Click to Save Answer &

ZOO201 – Animal Diversity: Invertebrates (Quiz No. 3)**Question # 2 of 10 (Start time: 06:43:50 AM, 02 March 2023)**

Larva of sea star is called _____.

Select the correct option

☐	Pupa
☐	Chrysalis
☐	Nymphs
☒	Bipinnaria



Quiz

vulms.vu.edu.pk



Each kind of individual in an insect colony is called a _____.

Select the correct option



Caste



clone



member



epitome

BC200205707: MUHAMMAD AHSAN IQBAL

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 9 of 10 (**Start time: 06:44:45 AM, 02 March 2022**)

Which of the following is the member of class Ophiuroidea?

Select the correct option

☐	Sea cucumber
☐	Sea urchin
☐	Sea star
☒	Brittle star

Question # 8 of 10 (**Start time: 06:43:55 AM, 02 March 2022**)

Which of the following shows paurometabolous metamorphosis?

Select the correct option

☒	Grasshoppers
☐	Honeybees
☐	Silverfish
☐	Butterflies

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 7 of 10 (**Start time: 06:42:51 AM, 02 March 2022**)

Which one of the following are exclusively marine animals?

Select the correct option

☐	fishes
☒	echinoderms
☐	cnidarians
☐	Molluscs

BC200205707: MUHAMMAD AHSAN IQBAL

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 4 of 10 (Start time: 06:41:14 AM, 02 March 2022)

Which one of the following structure plays role in gas exchange in star fish?

Select the correct option

☐	Ossicles
☐	Pedicellariae
☐	Canal system
☒	Dermal branchiae



Type here to search





BC200205707: MUHAMMAD AHSAN IQBAL

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 3 of 10 (Start time: 06:40:52 AM, 02 March 2022)

Water vascular system in echinoderms is also called _____

Select the correct option

☒	Aquiferous system
☐	Canal system
☐	Hemal system
☐	Vascular system





Type here to search



BC200205707: MUHAMMAD AHSAN IQBAL

ZOO201 - Animal Diversity: Invertebrates (Quiz No. 3)

Question # 1 of 10 (Start time: 06:39:47 AM, 02 March 2022)

In holometabolous metamorphosis, final process of emergence of adult from cocoon is called _____

Select the correct option

☐	Metamorphosis
☐	Ecdysis
☒	Ecdysis
☐	Unfolding



Type here to search



Question # 9 of 10 (**Start time: 11:08:56 PM, 01 March 2022**)

In social insects reproductive females referred to as _____.

Select the correct option

☐ worker

☐ drone

☐ caste

☒ queen

Question # 8 of 10 (Start time: 11:08:45 PM, 01 March 2022)

In asteriodes the larger, oral stomach, sometimes called the _____

Select the correct option

☐	pedicellariae
☒	cardiac stomach
☐	mesenteries
☐	pyloric system

Question # 7 of 10 (Start time: 11:08:34 PM, 01 March 2022)

The echinoderm skeleton consists of a series of calcium carbonate plates called

Select the correct option



ossicles



bones



Madriporites



Scales

Question # 6 of 10 (Start time: 11:08:25 PM, 01 March 2022)

Paurometabolous metamorphosis, immatures are called _____

Select the correct option

☐	naiads
☐	larvae
☒	Nymphs
☐	Pupa

_____ make up the class Asteroidea.

Select the correct option

<input data-bbox="97 819 197 920" type="radio"/>	Jelly fish
<input data-bbox="97 1122 197 1223" type="radio"/>	Feather star
<input data-bbox="97 1424 197 1525" type="radio"/>	Silver fish
<input checked="" data-bbox="97 1727 197 1827" type="radio"/>	star fish

ZOO201 – Animal Diversity: Invertebrates (Quiz No. 3)

Question # 9 of 10 (**Start time: 06:36:06 AM, 02 March 2022**)

Which of the following shows ametabolous metamorphosis?

Select the correct option

☐	Butterfly
☒	Silverfish
☐	Moth
☐	Cockroach

Question # 5 of 10 (**Start time: 04:12:38 PM, 01 March 2022**)

Which one of the following control the caste system in honey bees?

Select the correct option

☐	Behavior of worker bees
☐	Division of labour
☐	Reproductive potential
☒	A pheromone

Question # 3 of 10 (Start time: 04:11:10 PM, 01 March 2022)

A tube foot often has a _____ at its distal end.

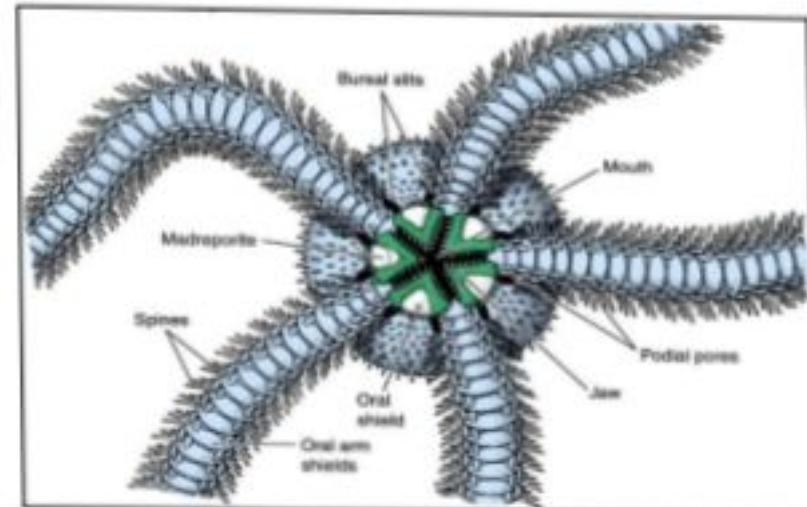
Select the correct option

☒	suction cup
☐	hook
☐	canal system
☐	madriporites

235

Phylum Echinodermata (Class **Ophiuroidea**: General Features)

- The class **Ophiuroidea** (Gr. *ophis*, snake *oura*, tail *oeides*, in the form of) includes the basket stars and the brittle stars.
- With over two thousand species, this is the most diverse group of echinoderms.
- Ophiuroids**, however, are often overlooked because of their small size and their tendency to occupy crevices in rocks and coral or to cling to algae.
- The arms of **ophiuroids** are long and, unlike those of asteroids, are sharply set off from the central disk, giving the central disk a pentagonal shape.
- Neither dermal branchiae nor pedicellariae are present in **ophiuroids**.



125

- The tube feet of **ophiuroids** lack suction disks and ampullae, and the contraction of muscles associated with the base of a tube foot extends the tube foot.
- Unlike the sea stars, the madreporite of **ophiuroids** is on the oral surface.
- Ophiuroidea** closely related to starfish.
- They crawl across the sea floor using their flexible arms for locomotion.

90

Sub-Phylum Hexapoda**Sex pheromones**

- Excite or attract members of the opposite sex; accelerate or retard sexual maturation.
- Example: Female moths produce and release **pheromones** that attract males.
- Sex **pheromones** act as a signal to attract potential mates over long distances (e.g. moths).
- Sensitive chemoreceptive sensilla in insects facilitate the detection of very low concentrations of sex **pheromones** in the environment.
- Release of sex **pheromones** may be governed by factors such as time of day, weather, and the availability of host plants.
- Furthermore, both the immature and adult stages of insects can sequester chemicals from host plants and use them as precursors for sex **pheromones**.
- Sex **pheromones** are highly species specific and, as a rule, a unique blend of the natural pheromone components is needed for attraction.

191

Sub-Phylum Hexapoda**Caste Regulating Pheromones**

- Used by social insects to control the development of individuals in a colony.
 - Example: The amount of “royal jelly” fed a female bee larva determines whether the larva will become a worker or a queen.
- Termites, a major group of social insects, exhibit many interesting phenomena related to social physiology, such as mechanisms of caste regulation in a colony.
- In their colonies, there are different types of individuals, i.e., castes, which show distinctive phenotypes specialized in specific colony tasks.
- Termite castes comprise reproductive, soldiers and workers, and the caste composition can be altered depending on circumstances.
 - For the regulation of caste compositions, interactions among individuals, i.e., social interactions, are thought to be important.

echinoderms evolved
from bilaterally symmetrical ancestors.

Phylum Echinodermata (Echinoderm: General Characteristics)

Phylum Echinodermata (Gr. *echinos*, spiny *derma*, skin *ata*, to bear) attached to their substrates and probably lived as filter feeders a feature found in only one class of modern echinoderms.

Characteristics of the phylum Echinodermata include:

1. Calcareous endoskeleton in the form of ossicles that arise from mesodermal tissue
2. Adults with pentaradial symmetry and larvae with bilateral symmetry
3. Water-vascular system composed of water-filled canals used in locomotion, attachment, and/or feeding
4. Complete digestive tract that may be secondarily reduced
5. Hemal system derived from coelomic cavities
6. Nervous system consisting of a nerve net, nerve ring, and radial

The approximately seven thousand species of living echinoderms are **exclusively** marine and occur at all depths in all oceans.

metamorphosis con 1 of 2

and other appendages help position the insects for mating.

- Mating behavior starts by locating mates.
- Male and female have different strategies toward copulation and reproduction.
- After locating mates is courtship; one male and female have encountered each other and proceed directly to copulation or may first engage in various rituals, collective courtship.
- The final ritual is copulation.

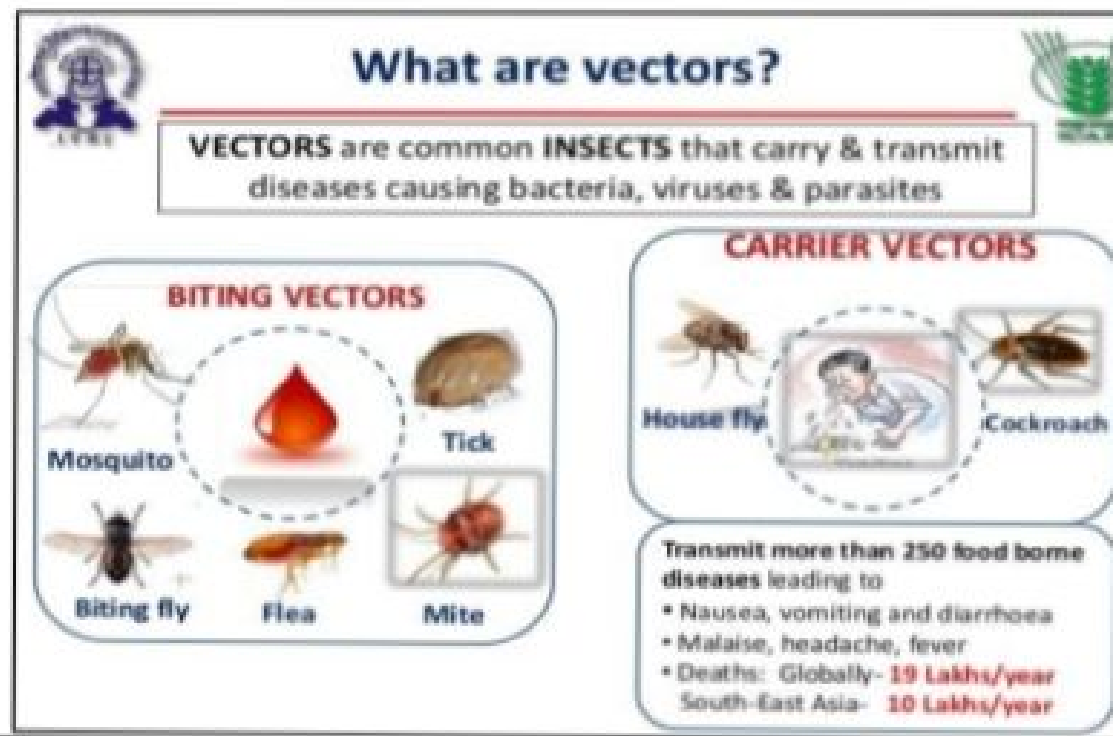
99 Sub-Phylum Hexapoda

Insect Development

- Insect evolution has resulted in the divergence of immature and adult body forms and functions.
- For insects in the superorder Endopterygota immature stages, called *larval instars*, are characterized by growth and accumulation of reserves for the transition to adulthood.
- The adult stage is associated with reproduction and dispersal.
- In these orders, insects tend to spend a greater part of their lives in juvenile stages.
- The developmental patterns of insects reflect degrees of divergence between immature and adult forms and are classified into three (or sometimes four) categories.
- Changes occur in the insect during the development from **egg** to the adult.
- Complete **metamorphosis** consists of four stages: **egg, larva, pupa, and adult**.
- Incomplete **metamorphosis** consists of three stages: **egg, nymph, and adult**.

Sub-Phylum Hexapoda (Insects as Parasites and Vectors of Disease)

- Some insects, however, are parasites and vectors of disease.
- Parasitic insects include head, body, and pubic lice (order Anoplura); bedbugs (order Hemiptera); and fleas (order Siphonaptera).
- **Parasites transmitted by insects** often circulate in the blood of the host, with the **parasite** residing in and damaging organs or other parts of the body.
- Other insects **transmit** disease-causing microorganisms, nematodes, and flatworms.
- Insect-transmitted diseases, such as malaria, yellow fever, bubonic plague, encephalitis, leishmaniasis, and typhus, have changed the course of history.
- Triatomine bugs are the vectors for Chagas disease.
- An insect that **transmits** a disease is known as a **vector**, and the disease is referred to as a **vector-borne disease**.



Phylum Hexapoda (**Paurometabolous Metamorphosis**)

Paurometabolous (Gr. *pauros*, small) metamorphosis involves a species-specific number of molts between egg and adult stages, during which immatures gradually take on the adult form.

The external wings develop (except in those insects, such as lice, that have secondarily lost wings), adult body size and proportions are attained, and the genitalia develop during this time.

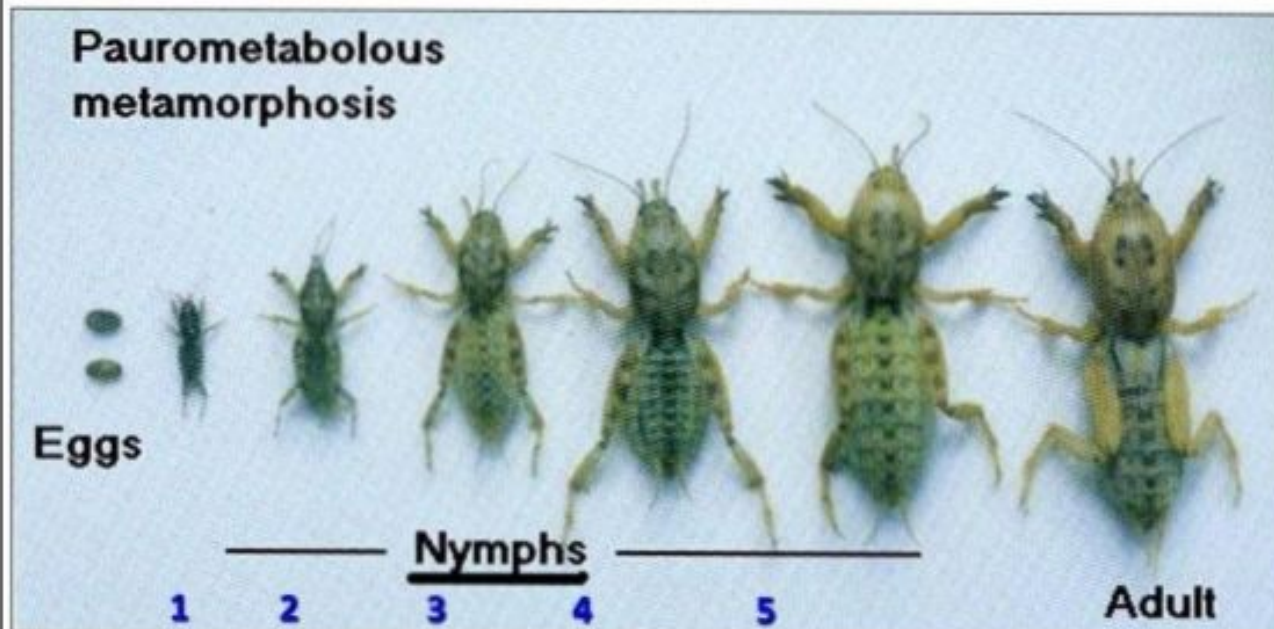
Immatures are called **nymphs**.

In this form of development, immature stages (nymphs) resemble small adults and typically have external wing buds.

They live in the same habitat as adults, typically taking the same food.

Grasshoppers (order Orthoptera) and chinch bugs (order Hemiptera) show **paurometabolous** metamorphosis.

Paurametabolous – gradual metamorphosis



Radial symmetry is adaptive for sedentary or slowly moving animals because it allows a uniform distribution of sensory, feeding, and other structures around the animal.

m Echinodermata (Echinoderm Skeleton)

The echinoderm skeleton consists of a series of **calcium** carbonate plates called **ossicles**.

These plates are derived from mesoderm, held in place by connective tissues, and covered by an epidermal layer.

If the epidermal layer is abraded away, the skeleton may be exposed in some body regions.

The skeleton is frequently modified into fixed or articulated spines that project from the body surface.

Some echinoderms have very tightly interlocking plates, like sea urchins.

In sea urchins and sand dollars, these interlocking plates form an enclosure, almost like a shell, called a **test**.

Sea urchins also have spines protruding from their tests, in life.

Others have more movable plates, like sea stars or starfish.

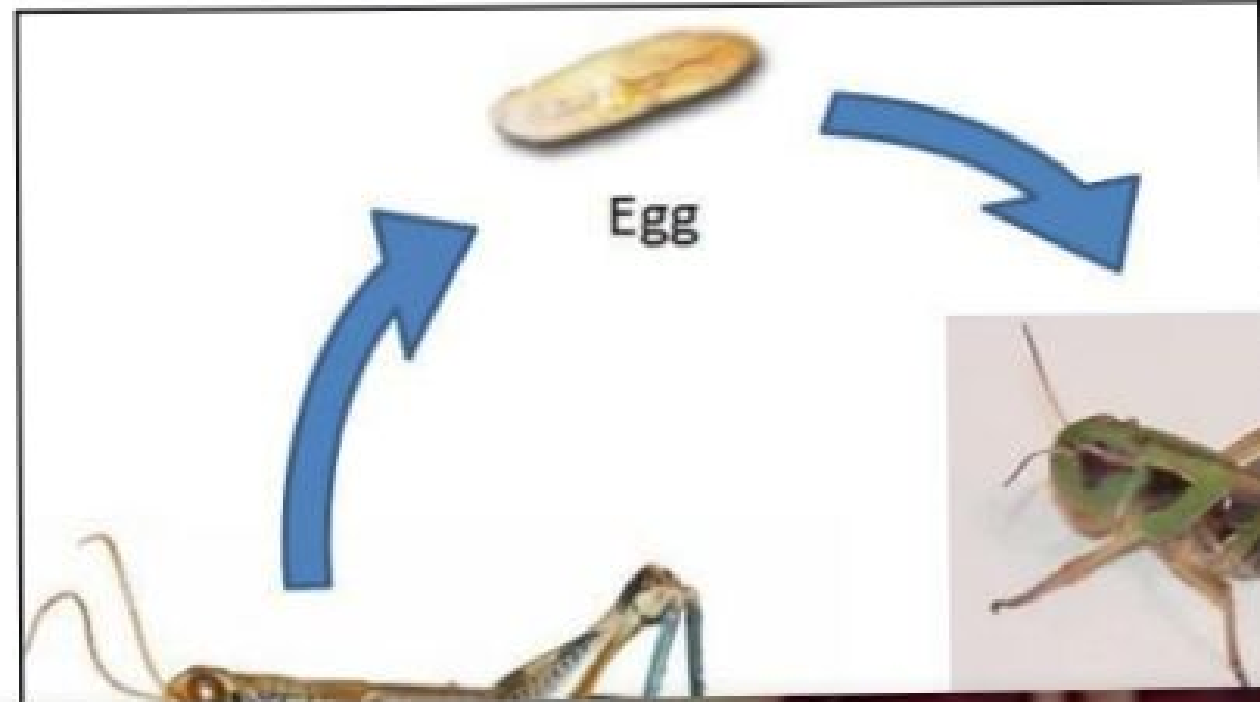
Sea cucumbers, the worm-like echinoderms, have an endoskeleton that is nearly microscopic.

They may not have as strong a defense system, but they are much more flexible and movable.

m Echinodermata (Echinoderm Skeleton)

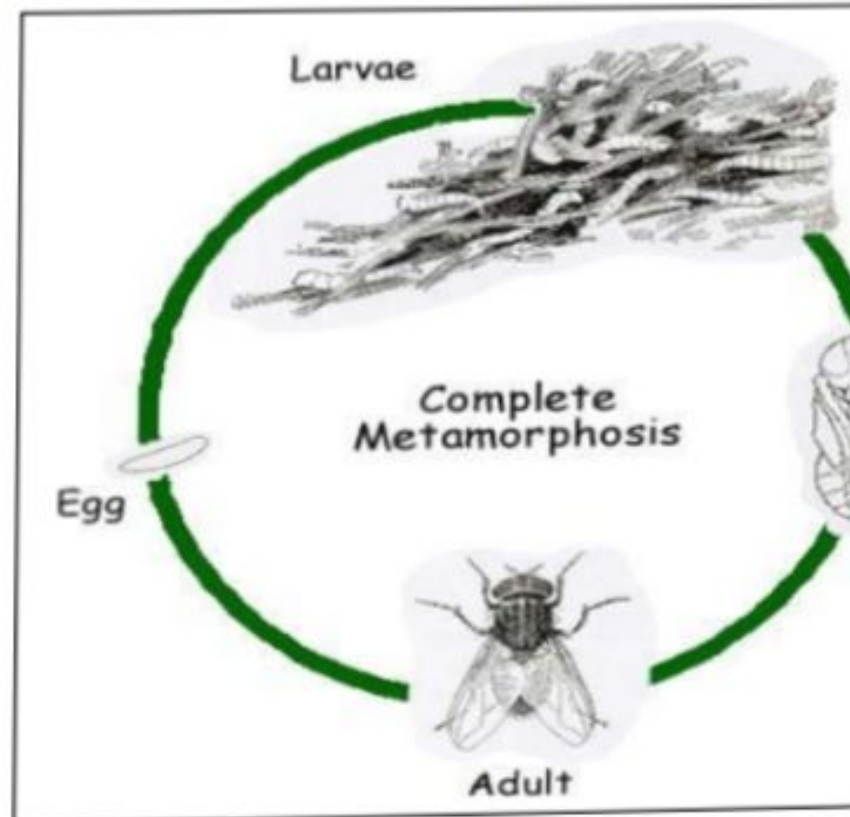
Sub-Phylum Hexapoda (**Hemimetabolous** Metamorphosis)

- Some zoologists use an additional classification for insects that have a series of changes in their development, but whose immature form is much different from the adult form usually due to the presence of gills (e.g., mayflies, order Ephemeroptera; dragonflies, order Odonata).
- This kind of development is called **hemimetabolous** (Gr. *hemi*, half) metamorphosis. The immatures are aquatic and called **naiads** (L. *naiad*, water nymph).
- Insects that undergo **hemimetabolous** metamorphosis emerge from the egg into nymphs (called larvae by some entomologists) that are similar in shape to the adult.
- They go through several nymphal stages (called instars) before they undergo a final molt into their adult form.
- Also known as incomplete or simple **metamorphosis**.
- The nymph, or immature insect, resembles the adult in form and eating habits.



Sub-Phylum Hexapoda (**Holometabolous** Metamorphosis)

- In **holometabolous** (Gr. *holos*, whole) metamorphosis, immatures are called because they are very different from the adult in body form, behavior, and habitat.
- The number of larval instars is species specific, and the last larval molt forms the pupa.
- The pupa is a time of apparent inactivity but is actually a time of radical cellular changes during which all characteristics of the adult insect develop.
- A protective case may enclose the pupal stage.
- The last larval instar (e.g., moths, order Lepidoptera) constructs a **cocoon** **partially** **entirely from silk**.
- **The chrysalis** (e.g., butterflies, order Lepidoptera) and **puparium** (e.g., flies, order Diptera) are the last larval exoskeletons and are retained through the pupal stage.
- Other insects (e.g., mosquitoes, order Diptera) have pupae that are unenclosed by a larval exoskeleton, and the pupa may be active.
- The final molt to the adult stage usually occurs within the cocoon, chrysalis, or puparium, and the adult then exits, frequently using its mandibles to open the cocoon or other enclosure.
- This final process is called emergence or eclosion.

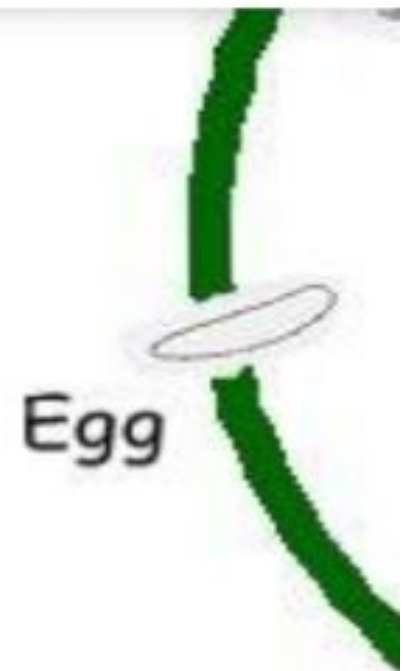




exoskeleton, and the pupa may be active.

The final molt to the adult stage usually occurs within the cocoon, chrysalis, or puparium, and the adult then exits, frequently using its mandibles to open the cocoon or other enclosure.

This final process is called emergence or **eclosion**.



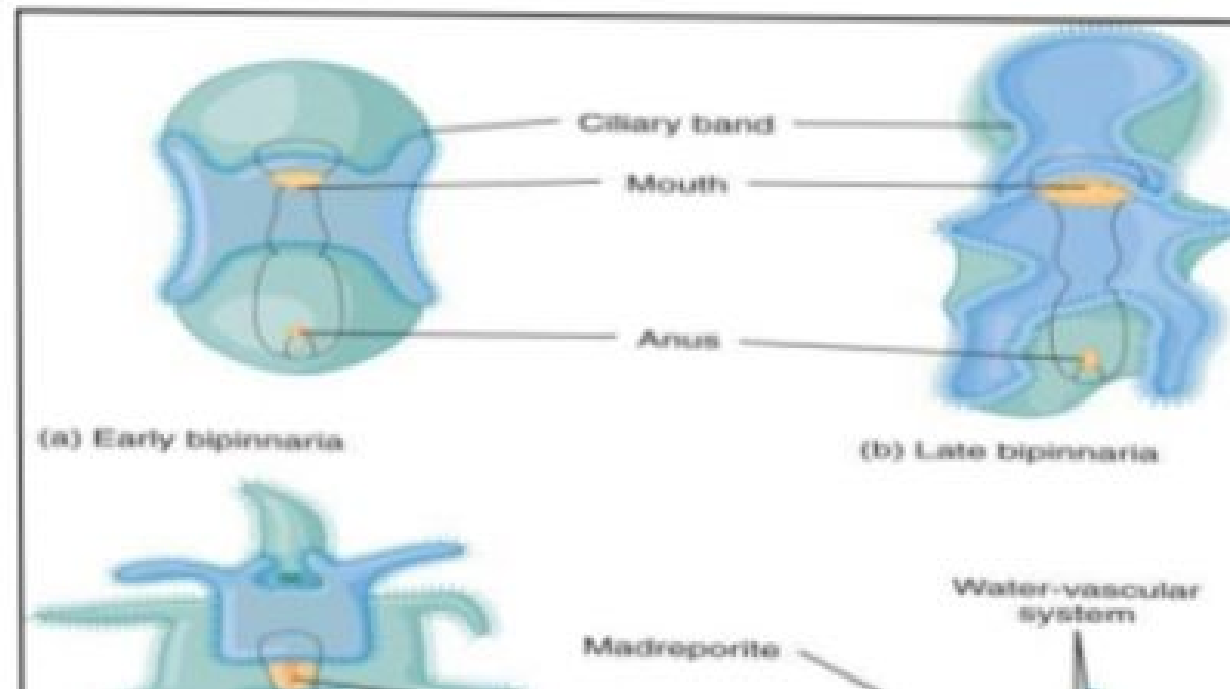
Sub-Phylum Hexapoda (**Paurometabolous** Metamorphosis)

- **Paurometabolous** (Gr. *pauros*, small) metamorphosis involves a species-specific number of molts between egg and adult stages, during which immatures gradually take on adult form.
- The external wings develop (except in those insects, such as lice, that have secondarily lost wings), adult body size and proportions are attained, and the genitalia develop at the same time.
- Immatures are called **nymphs**.
- In this form of development, immature stages (nymphs) resemble small adults and have external wing buds.
- They live in the same habitat as adults, typically taking the same food.
- Grasshoppers (order Orthoptera) and chinch bugs (order Hemiptera) show **paurometabolous** metamorphosis.

- In other species, a male and female may come together and form a pair.

ylum Echinodermata (Development in **Sea Star**)

- Embryos are planktonic, and cilia are used in swimming.
 - After gastrulation, bands of cilia differentiate, and a bilaterally symmetrical larva, called **bipinnaria** larva, forms.
 - The larva usually feeds on planktonic protists.
 - The development of larval arms results in a **brachiolaria** larva, which settles to the substrate, attaches, and metamorphoses into a juvenile **sea star**.
 - Later embryonic stages are ciliated and swim and feed in the plankton.
 - In a few species, embryos develop from yolk stored in the egg during gamete formation.
 - Oocytes averaged 137 μm in diameter, the smallest reported in the genus.
- Fertilized oocytes developed into feeding bipinnaria larvae that fed in the plankton for at least 4 weeks, and in some cases up to 33 weeks, before metamorphosis.





ylum Echinodermata (Feeding and Digestion in Star Fish)

- Sea stars feed on snails, bivalves, crustaceans, polychaetes, corals, detritus, food items.
- The mouth opens to a short esophagus and then to a large stomach that fills the central disk.
- The stomach is divided into two regions.
- The larger, **oral stomach**, sometimes called the **cardiac stomach**, receives ingested food.
- It joins the smaller, **aboral stomach**, sometimes called the **pyloric stomach**.
- The aboral (pyloric) stomach gives rise to ducts that connect to secretory organs called pyloric caecae.

clams, and other mollusks.

The larval form of the urochordate (e.g., the tunicate, or sea squirt) is tadpole-like and free swimming; the adult is sessile and somewhat degenerate.

Among the most dramatic and thoroughly studied examples of metamorphosis are the insects. Because development is not the same in all insects, it is convenient to group them into major categories according to the pattern of structural changes: **ametabolous**, hemimetabolous, and holometabolous.

In **ametabolous** development there is simply a gradual increase in the size of young until adult dimensions are attained.

This kind of development occurs in the silverfish, springtail, and other primitive insects.

In more advanced insects (e.g., grasshoppers, termites, true bugs) a phenomenon known as gradual, or **hemimetabolous**, metamorphosis occurs.

The hemimetabolous life cycle consists of egg, nymph, and adult.

The nymph, or immature insect, resembles the adult in form and eating habits, differing in size, body proportions, and color pattern.

Complete, or **holometabolous**, metamorphosis is characteristic of beetles, butterflies and moths, flies, and wasps.

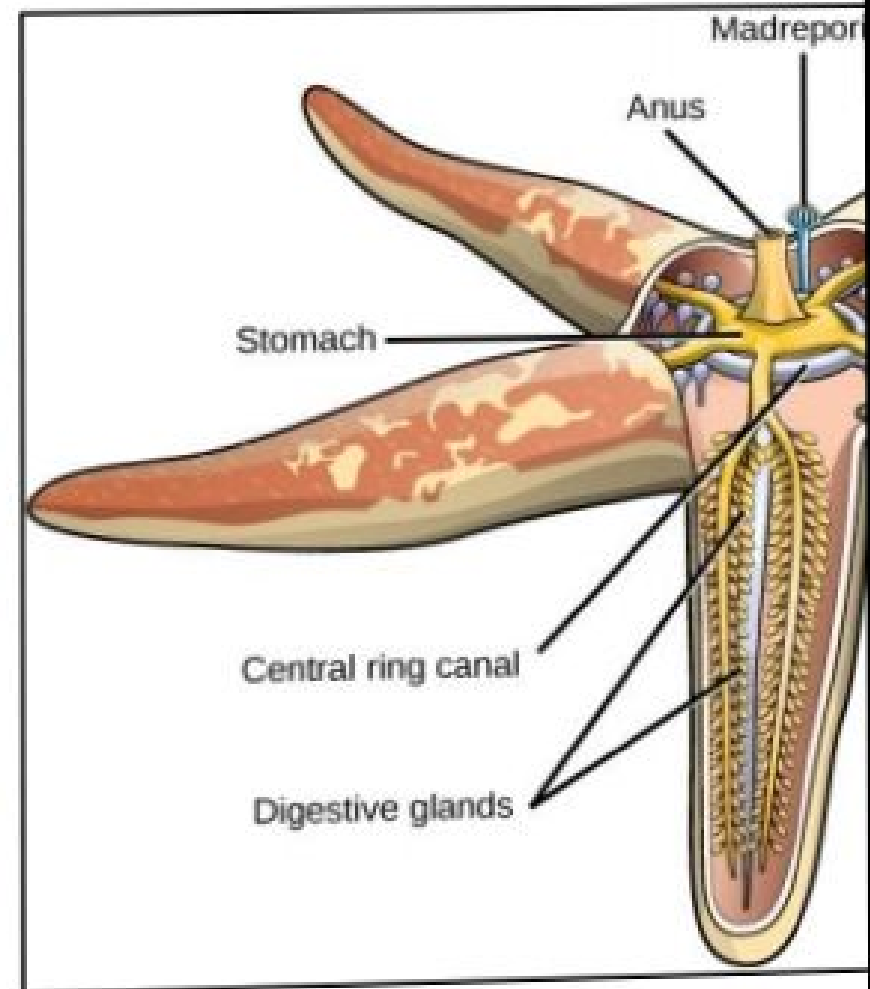
Their life cycle includes four stages: egg, larva, pupa, and adult.

The larva differs greatly from the adult.

It is wingless, and its form and habits are suited for growth and development rather than reproduction.

Phylum Echinodermata (Structure and Function of Tube Feet)

- **Tube** feet are extensions of the canal system and usually emerge through the ossicles.
- Internally, **tube** feet usually terminate in a bulblike, muscular ampulla.
- When an ampulla contracts, it forces water into the **tube** foot, which then extends.
- Valves prevent the backflow of water from the **tube** foot into the lateral canal.
- A **tube** foot often has a suction cup at its distal end.
- When the foot extends and contacts solid substrate, muscles of the suction cup contract and create a vacuum.
- In some taxa, **tube** feet have a pointed or blunt distal end.
- These echinoderms may extend their **tube** feet into a soft substrate to secure contact during locomotion or to sift sediment during feeding.



Echinodermata (Functions of Water Vascular System)

Sub-Phylum Hexapoda (Caste System in Honey Bees)

- Honeybees (order Hymenoptera) have three of these castes in their colonies.
- A single **queen** lays all the eggs.
- Workers are female, and they construct the comb out of wax that they produce.
- They also gather nectar and pollen, feed the **queen** and drones, care for the larvae,

honeybee
(*Apis mellifera*)



worker

- Movable and fixed spines project from the skeleton and roughen the aboral surface.

Phylum Echinodermata (Dermal Branchiae)

- Thin folds of the body wall, called **dermal branchiae**, extend between ossicles and function in **gas exchange**.
- **Papulae**, known as, **Dermal branchiae** or **skin gills**, are projections of the coelom of **Asteroidea** that serve in respiration and waste removal.
- Papulae are soft, covered externally with the epidermis, and lined internally with peritoneum.
- They extend through the mesodermal ossicles and are protected from microscopic larvae by pedicellariae.
- In a living specimen, the **dermal gills** can be extended or withdrawn.

Dermal Branchiae

- Soft bumps on the body that absorb oxygen from the water



Phylum Echinodermata (Pedicellariae)

sediment during feeding.



Phylum Echinodermata (Functions of **Water Vascular System**)

- The madreporite may serve as an inlet to replace water lost from the water-vascular system and may help equalize pressure differences between the water-vascular system and the outside.
- Polian vesicles function in fluid storage for the water-vascular system.
- The water-vascular system has other functions in addition to locomotion.
- The original function of water-vascular systems was probably feeding, not locomotion.
- In addition, the soft membranes of the water-vascular system permit diffusion of respiratory gases and nitrogenous wastes across the body wall.
- Other terms sometimes used to refer to the **water vascular** system are "ambulacral system" and "aquiferous system".

Phylum Echinodermata (Hemal System)

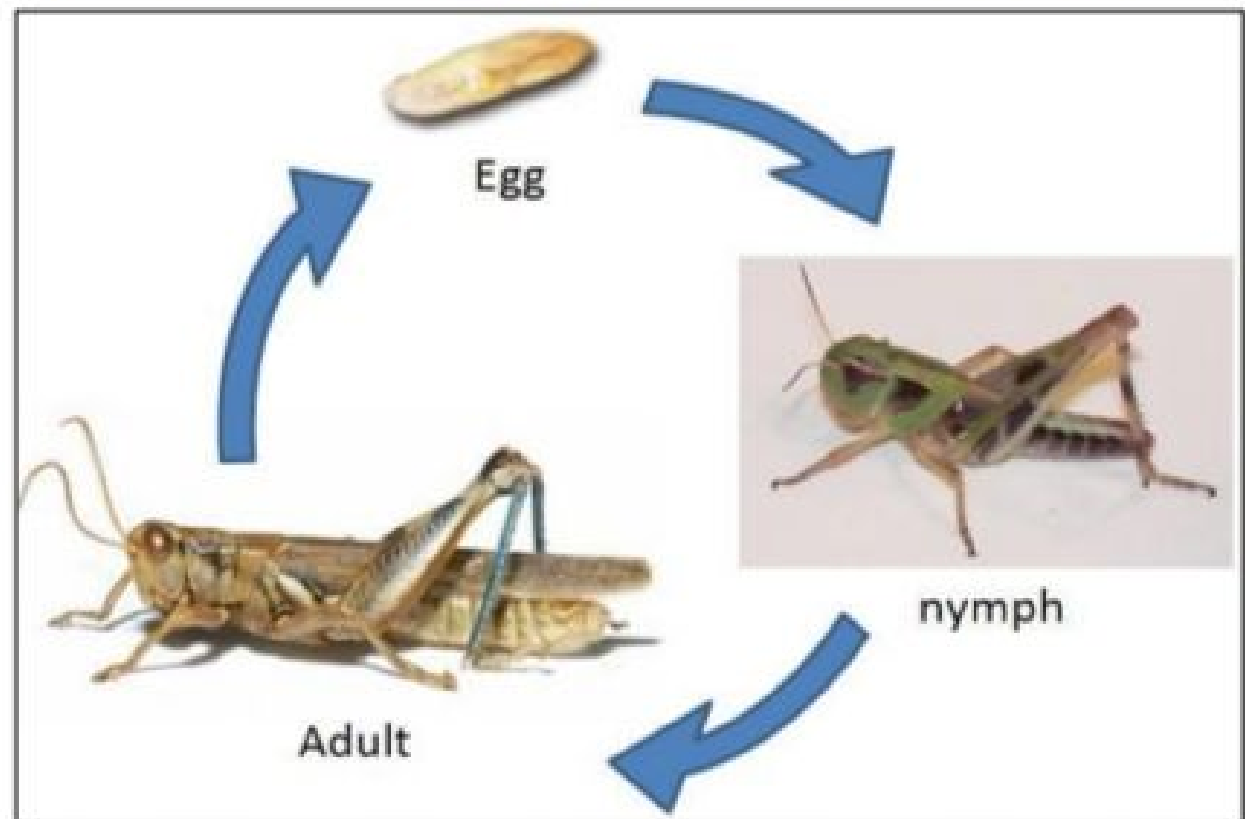
Sub-Phylum Hexapoda

Caste Regulating Pheromones

- Used by social insects to control the development of individuals in a colony.
- Example: The amount of “royal jelly” fed a female bee larva determines whether the larva will become a worker or a queen.
- Termites, a major group of social insects, exhibit many interesting phenomena related to social physiology, such as mechanisms of **caste** regulation in a colony.
- In their colonies, there are different types of individuals, i.e., **castes**, which show distinctive phenotypes specialized in specific colony tasks.
- Termite **castes** comprise reproductive, soldiers and workers, and the **caste** composition can be altered depending on circumstances.
- For the regulation of **caste** compositions, interactions among individuals, i.e., social interactions, are thought to be important.

Sub-Phylum Hexapoda (Hemimetabolous Metamorphosis)

- Some zoologists use an additional classification for insects that have a series of gradual changes in their development, but whose immature form is much different from the adult form usually due to the presence of gills (e.g., mayflies, order Ephemeroptera; dragonflies, order Odonata).
- This **kind of** development is called **hemimetabolous** (Gr. *hemi*, half) **metamorphosis**, and the immatures are aquatic and called **naiads** (L. *naiad*, water nymph).
- Insects that undergo **hemimetabolous metamorphosis** emerge from eggs into nymphs (called larvae by some entomologists) that are similar in shape to the adults.
- They go through several nymphal stages (called instars) before they undergo a final molt into their adult form.
- Also known as incomplete or simple **metamorphosis**.
- The nymph, or immature insect, resembles the adult in form and eating habits, differing in size, body proportions, and color pattern.



swimming, the adult is sessile and somewhat degenerate.

- Among the most dramatic and thoroughly studied examples of metamorphosis are the insects.
- Because development is not the same in all insects, it is convenient to group them into major categories according to the pattern of structural changes: ametabolous, **hemimetabolous**, and holometabolous.
- In **ametabolous** development there is simply a gradual increase in the size of young until adult dimensions are attained.
- This kind of development occurs in the silverfish, springtail, and other primitive insects.
- In more advanced insects (*e.g.*, grasshoppers, termites, true bugs) a phenomenon known as gradual, or **hemimetabolous**, metamorphosis occurs.
- The **hemimetabolous** life cycle consists of egg, nymph, and adult.
- The nymph, or immature insect, resembles the adult in form and eating habits, differing in size, body proportions, and color pattern.
- Complete, or **holometabolous**, metamorphosis is characteristic of beetles, butterflies and moths, flies, and wasps.
- Their life cycle includes four stages: egg, larva, pupa, and adult.
- The larva differs greatly from the adult.
- It is wingless, and its form and habits are suited for growth and development rather than reproduction.