

Insect Development

ENTOMOLOGY

2002

Reproduction



**Prepared
by
Suput@**

Agriculture Dept. Gadjah Mada University

References

- **Anonimous, 1995.** *Encyclopedia of Nature.* Dorling Kindersley Multimedia. CD ROM.
- **_____ , WY.** *Encyclopedia of Animals.* Volume 7. Insects and Spiders. VCD.
- **Borror, D.J. & D.M. Delong. 1971.** *An Introduction to the Study of Insects.* Third Edition. Holt, Rinehart, and Winston INC. Printed in the United State of America. 812 pages.
- **Bryant, P.J., M. Filippova, & P. Havie. WY.** *Neuroendocrine Control of Insect Development.* Developmental Biology Center. University of California. Irvine. CA 92717. USA. On-Line.
- **Chapman, R.F. 1982.** *The Insect Structure and Functions.* Third Edition. Harvard University Press. Cambridge. Massachusetts. Hong Kong. 919 pages.
- **Farb. P. 1981.** Serangga. Pustaka Alam Life. Authorized Indonesian Language Edition. Tira Pustaka. Jakarta. 192 pages.
- **Hallick, R.B. 2000.** *The Effects of Juvenile Hormone and Juvenile Hormone Mimics on Adult Development of Drosophila melanogaster.* The University of Arizona. On-Line.
- **Hallick, R.B. 2000.** *Vertebrate Development: Clavage.* Chapter 40: Animal Development. The University of Arizona. On-Line.

References

- Anonymous, 1995. *Encyclopedia of Nature*. Dorling Kindersley Multimedia. CD ROM.
- _____, WY. *Encyclopedia of Animals*. Volume 7. Insects and Spiders. VCD.
- **Borror, D.J. & D.M. DeLong. 1971. *An Introduction to the Study of Insects*. Third Edition. Holt, Rinehart, and Winston INC. Printed in the United State of America. 812 pages.**
- Bryant, P.J., M. Filippova, & P. Havie. WY. *Neuroendocrine Control of Insect Development*. Developmental Biology Center, University of California, Irvine, CA 92717, USA. On-Line.
- **Chapman, R.F. 1982. *The Insect Structure and Functions*. Third Edition. Harvard University Press. Cambridge, Massachusetts. Hong Kong. 919 pages.**
- Farb, P. 1981. Serangga. Pustaka Alam Life. Authorized Indonesian Language Edition. Tira Pustaka, Jakarta. 192 pages.
- Hallick, R.B. 2000. *The Effects of Juvenile Hormone and Juvenile Hormone Mimics on Adult Development of Drosophila melanogaster*. The University of Arizona. On-Line.
- Hallick, R.B. 2000. *Vertebrate Development: Clavage*. Chapter 40: Animal Development. The University of Arizona. On-Line.

References

- **Happ, G.M.** *Development and Reproduction*. Chapter Four. *In H.E. Evans. 1984. Insect Biology. A Textbook of Entomology.* Colorado State University. Addison-Wesley Publishing Company. Massachusetts. California. London. Amsterdam. Ontario. Sydney. Page 93-113.
- **Oberlander, H.** Hormon Action During Insect Development. Chapter 13. *In M.S. Blum. 1985. Fundamentals of Insect Physiology.* A Wiley-Interscience Publication. John Wiley and Sons. New York. Chichester. Brisbane. Toronto. Singapore. Page 59-90.
- **Powell, P.K. 1995.** *Insect Metamorphosis.* Extension Service. West Virginia University. On-Line.
- **Riddiford, L.M., T.J.W. 2000.** *The Origins of Insect Metamorphosis.* Departement of Zoology. University of Washington. Seattle 98195-1800. USA. On-Line.
- **Stricherz, V. 1999.** *Researchers Say Hormones are Key to Evolution of Insect Metamorphosis.* For Intermediate Release. University of Washington. On-Line.
- **Yahya, H. 2002.** The Fact of Creation. Harunyahya Channel. VCD

References

- **Happ, G.M. *Development and Reproduction*. Chapter Four. In H.E. Evans. 1984. *Insect Biology. A Textbook of Entomology*. Colorado State University. Addison-Wesley Publishing Company. Massachusetts. California. London. Amsterdam. Ontario. Sydney. Page 93-113.**
- Oberlander, H. Hormon Action During Insect Development. Chapter 13. In M.S. Blum. 1985. *Fundamentals of Insect Physiology*. A Wiley-Interscience Publication. John Wiley and Sons. New York. Chichester. Brisbane. Toronto. Singapore. Page 59-90.
- Powell, P.K. 1995. *Insect Metamorphosis*. Extension Service. West Virginia University. On-Line.
- Riddiford, L.M., T.J.W. 2000. *The Origins of Insect Metamorphosis*. Departement of Zoology. University of Washington. Seattle 98195-1800. USA. On-Line.
- Stricherz, V. 1999. *Researchers Say Hormones are Key to Evolution of Insect Metamorphosis*. For Intermediate Release. University of Washington. On-Line.
- Yahya, H. 2002. *The Fact of Creation*. Harunyahya Channel. VCD



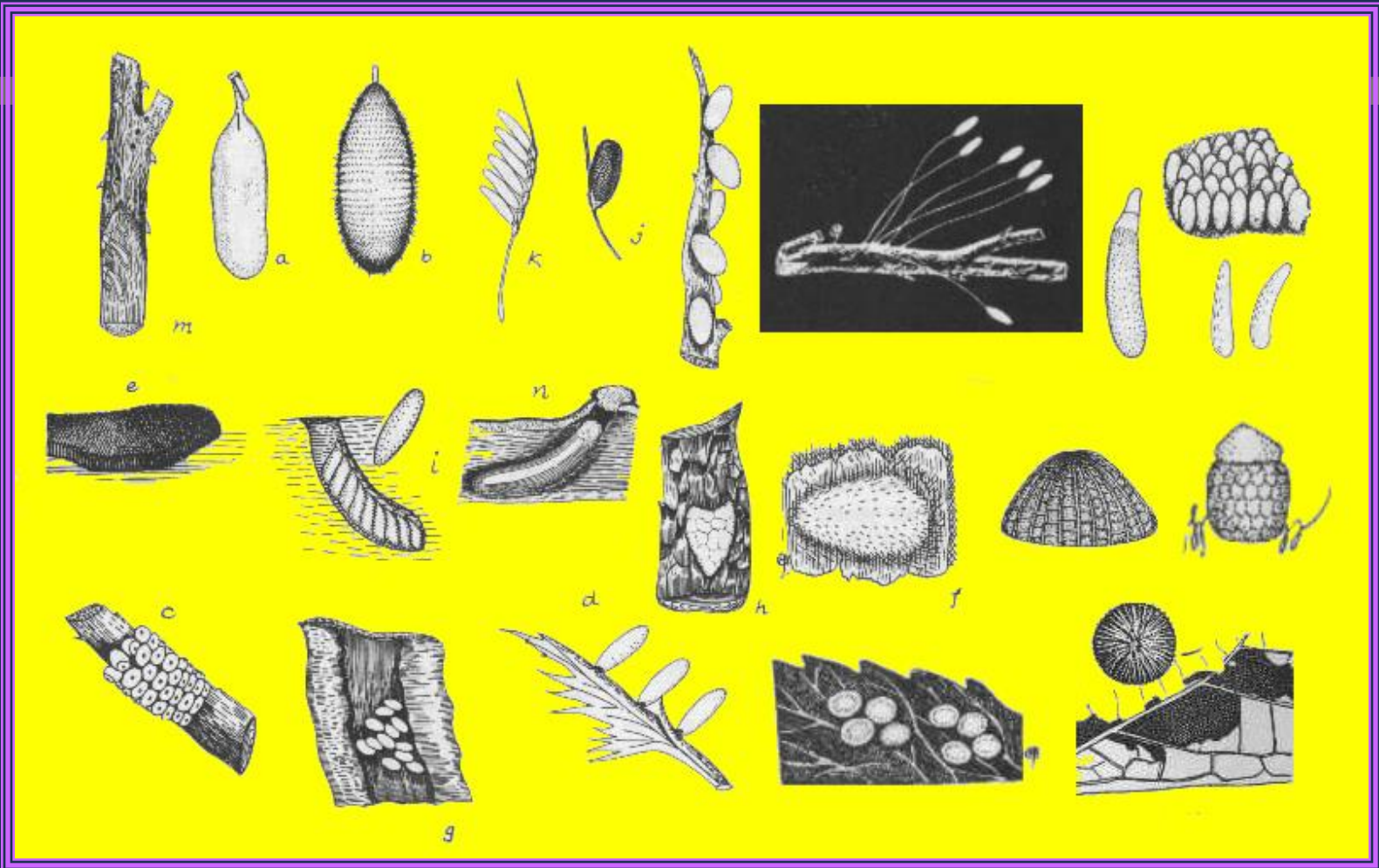
Types of Insect Reproduction

- **Oviparity**
- **Ovoviviparity**
- **Viviparity**

Fecundity, Fertility



Morphology of Insect Eggs



Types of Insect Reproduction

Oviparity





Types of Insect Reproduction

Oviparity





Types of Insect Reproduction

Oviparity





Types of Insect Reproduction

Oviparity



Types of Insect Reproduction

Viviparity





Types of Insect Reproduction

- **Polyembryony**
- **Parthenogenesis**
 - 1. Arrhenotoky
 - 2. Thelytoky
 - 3. Amphitoky
- **Paedogenesis**





Three Phases of Insect Development

- **Embryo**
- **Immature**
- **Adult / Imago**






Three Phases of Insect Development

- **Embryo**
- Immature
- Adult / Imago





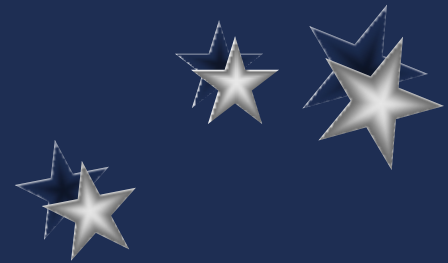
Stages in Insect Embryology ... 1

- ❖ Egg Fertilized
 - ❖ Cleavage nuclei migrate to egg surface
 - ❖ Blastoderm - a thin cellular layer
 - ❖ Sperm production
 - ❖ Fertilization
 - ❖ Vitellogenesis or yolk formation in egg
 - ❖ Formation of egg chorion or “shell”
- 

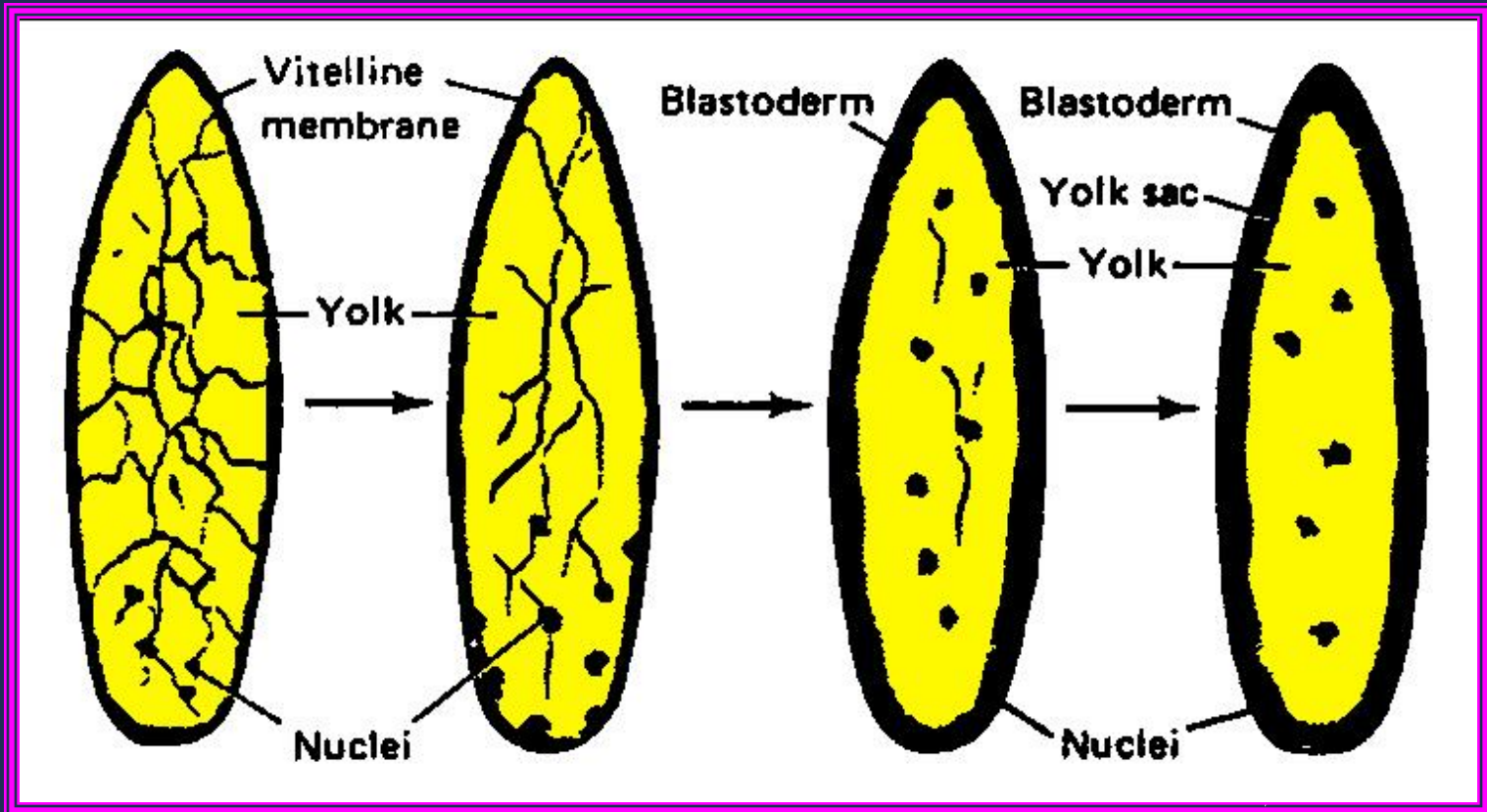


Stages in Insect Embryology ... 2

- ❖ Germ band forms
- ❖ Germ band invaginates into yolk
- ❖ Three primary tissues develop



Embryonic Development in an Insect





Stages in Insect Embryology ... 2

- ❖ Germ band forms
- ❖ Germ band invaginates into yolk
- ❖ **Three primary tissues develop**



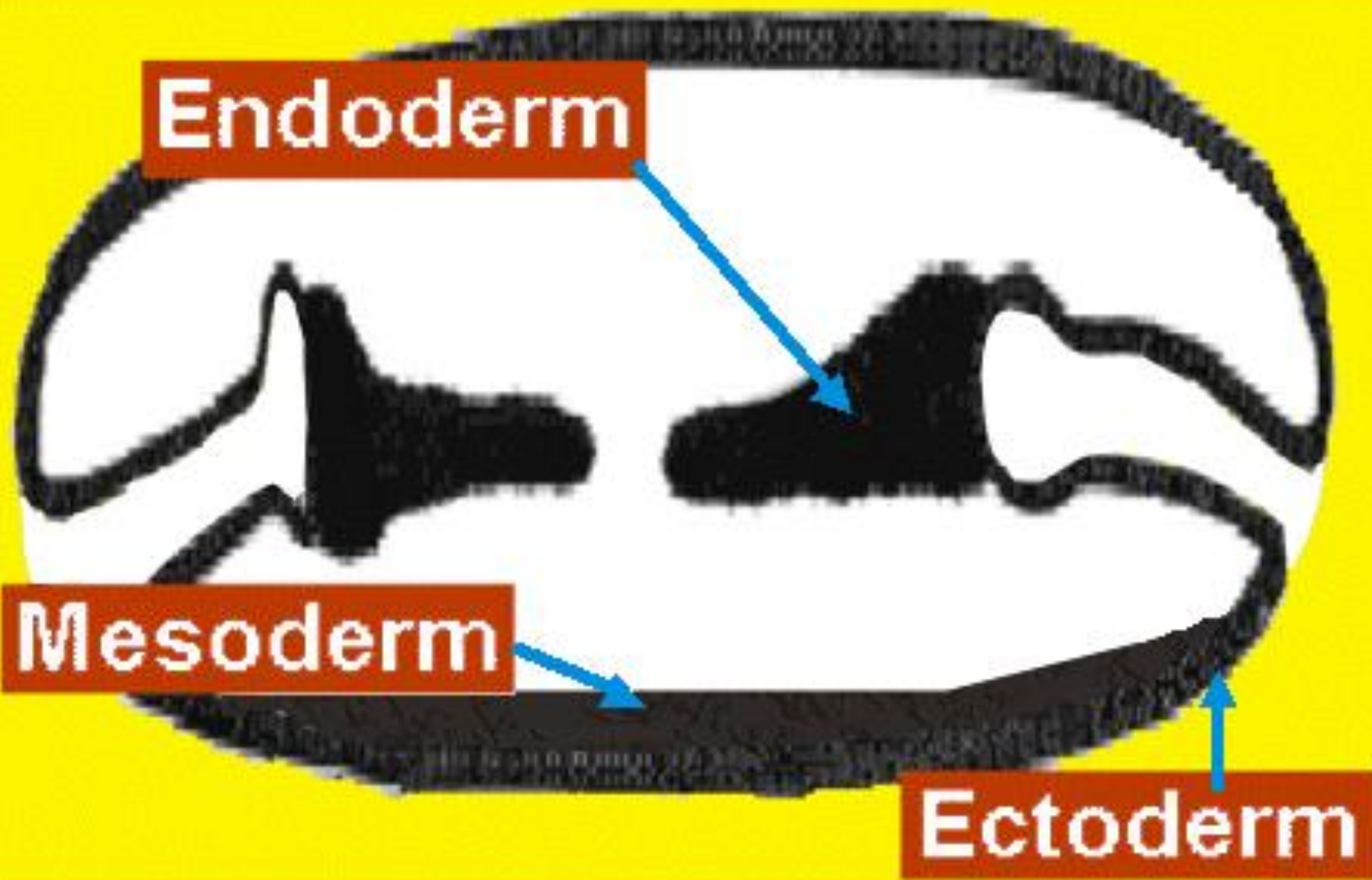


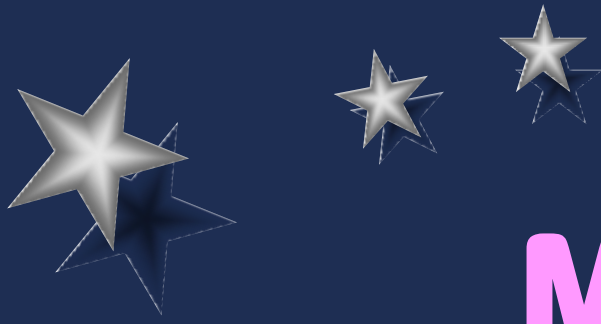
Three Primary Tissues Develop

- Mesoderm
- Endoderm
- Ectoderm



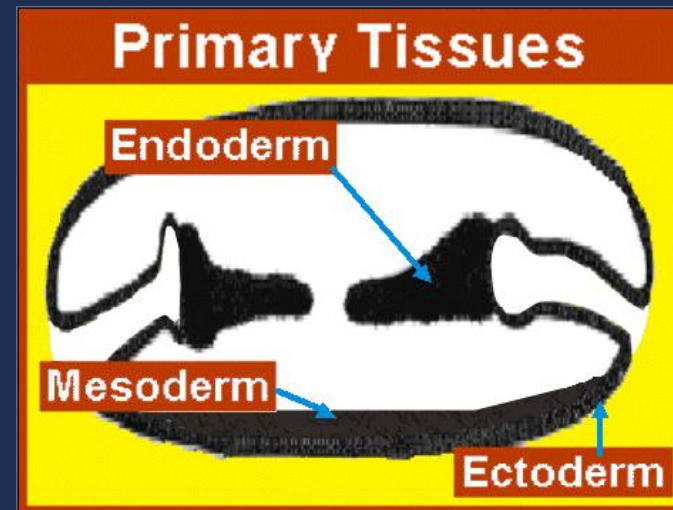
Primary Tissues

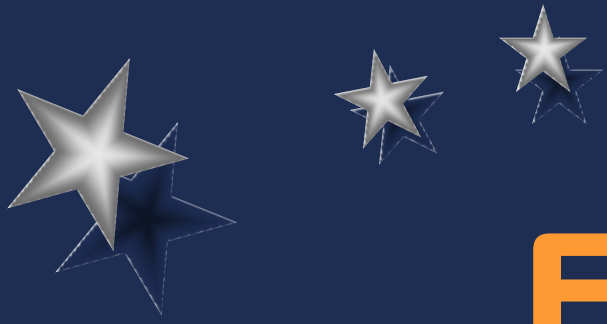




Mesoderm

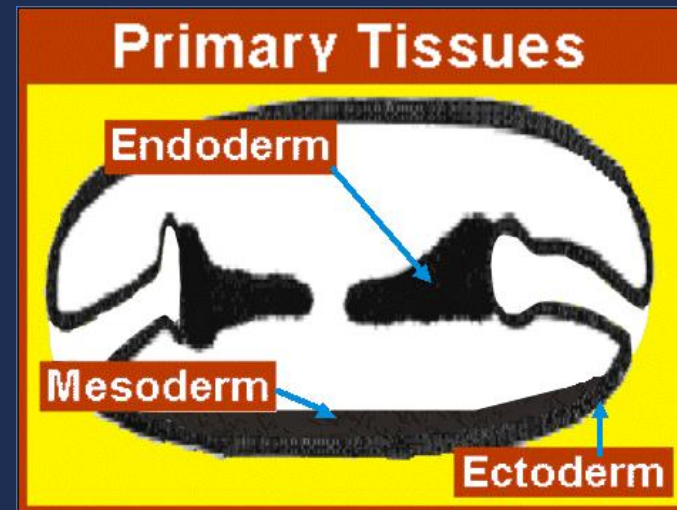
- Inner layer
- Muscles, fat bodies, gonads

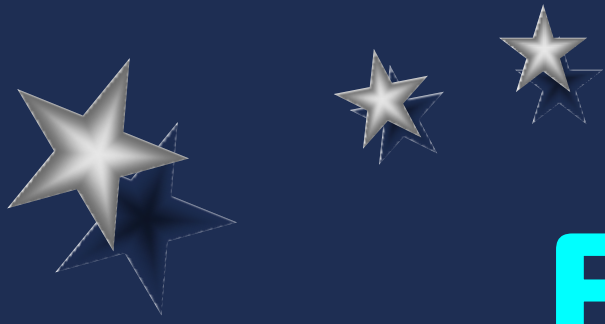




Endoderm

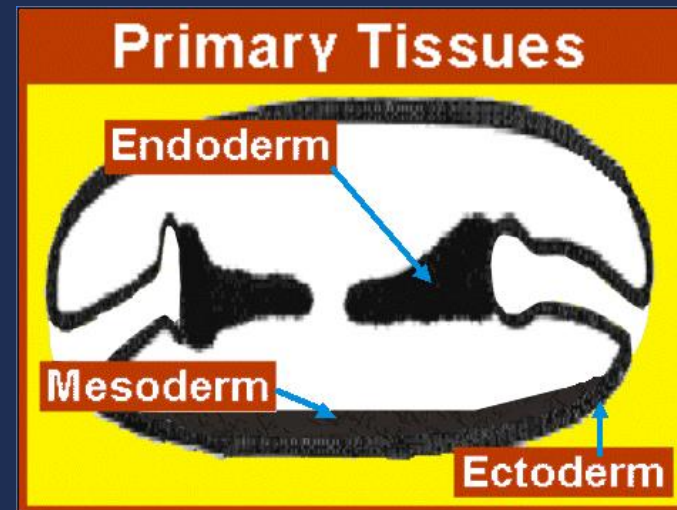
- Middle layer
- Gut or digestive tract





Ectoderm

- Outer layer
- Fore gut, Hind gut, Wings, Tracheal lining





An Egg is Hatching



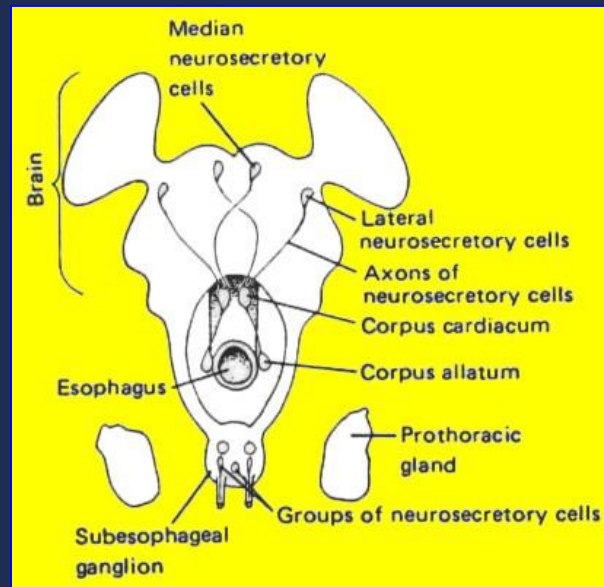


**The Reproductive
Processes is Controlled
by Endocrine System**



The Endocrine System

A relatively fast internal communication system related to nervous system



Chemical messengers or “hormones” in hemolymph
Hormones secreted by cells, often in the brain



Endocrine Control of:

- Reproductive processes, development, breaking diapause,
- Behavior-Migration, mating, egg laying,
- Homeostasis-sugar, fat and protein production and use





Endocrine Control of:

- Reproductive processes, **development**, breaking diapause,
- Behavior-Migration, mating, egg laying,
- Homeostasis-sugar, fat and protein production and use





Three Phases of Insect Development

- **Embryo**
- Immature
- Adult / Imago





Three Phases of Insect Development

- Embryo
- **Immature**
- Adult / Imago



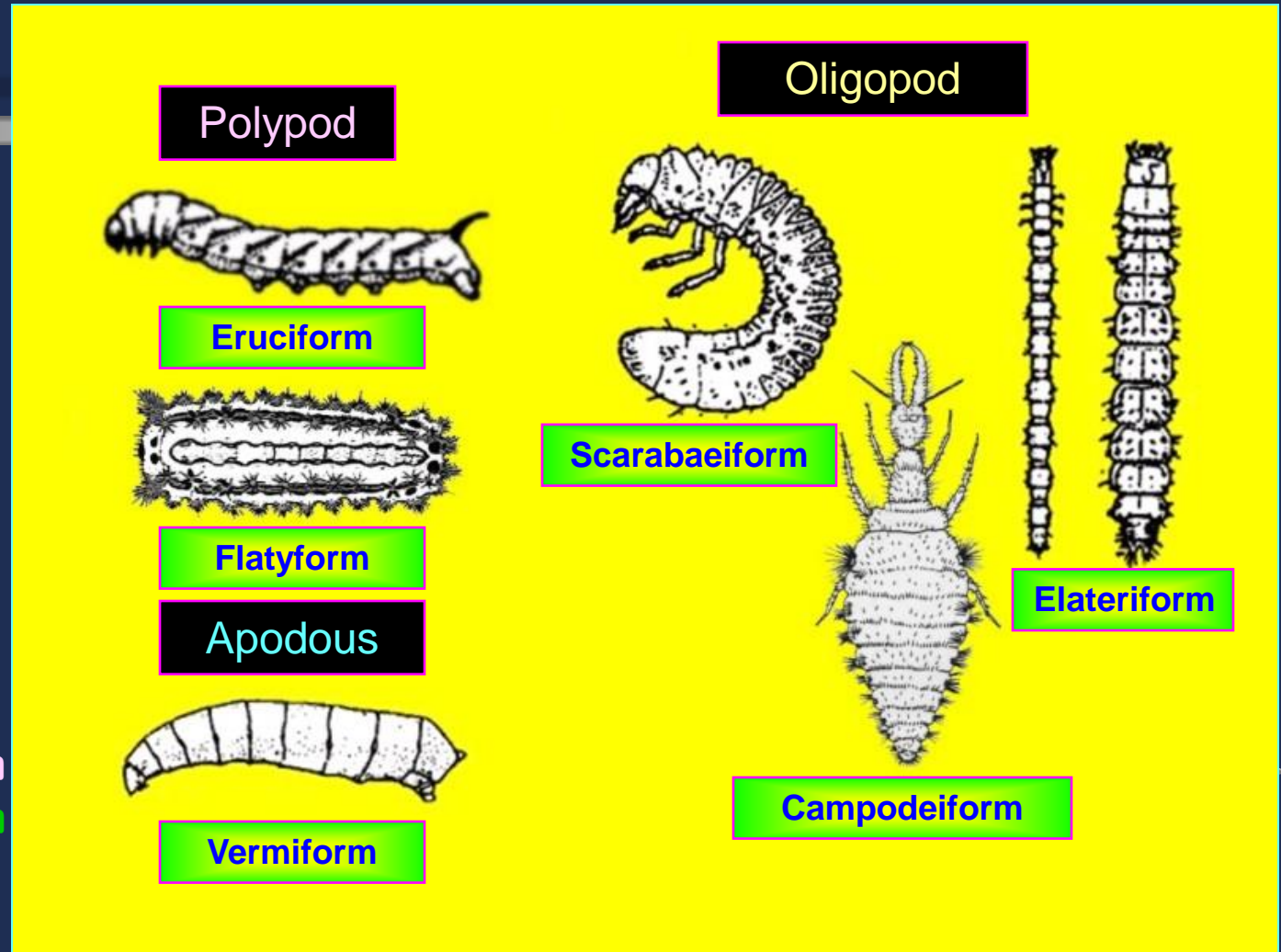
Types of Larvae

Leg:

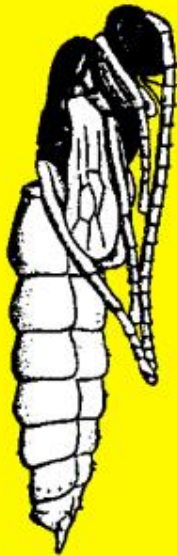
- Polypod
- Oligopod
- Apodous

Form:

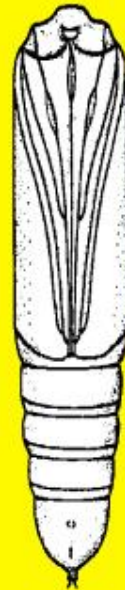
- Eruciform
- Flatyform
- Scarabaeiform
- Campodeiform
- Elateriform
- Vermiform



Types of Pupae



Exarate



Obtect

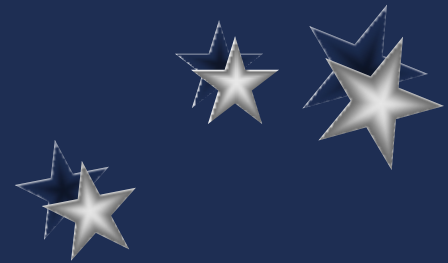


Coarctate



How Insects Grow

○ METAMORPHOSIS





Types of Metamorphosis

- **Simple Metamorphosis**

- No Metamorphosis (ametabolous development)
- Incomplete Metamorphosis (hemimetabolous development)
- Gradual Metamorphosis (paurometabolous development)

- **Complete Metamorphosis**

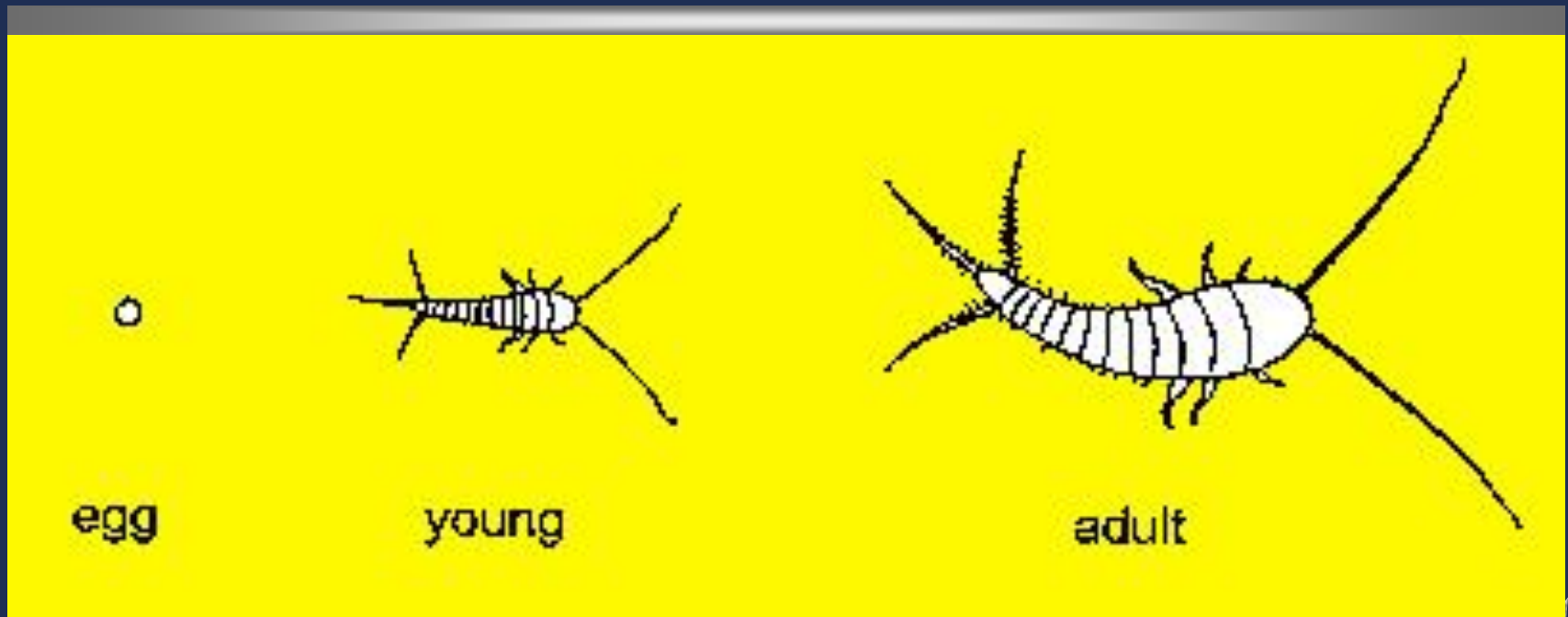
- (holometabolous development)

- **Intermediary Metamorphosis**

- (paurometabolous & holometabolous development)
- 

Simple Metamorphosis

No Metamorphosis



Simple Metamorphosis

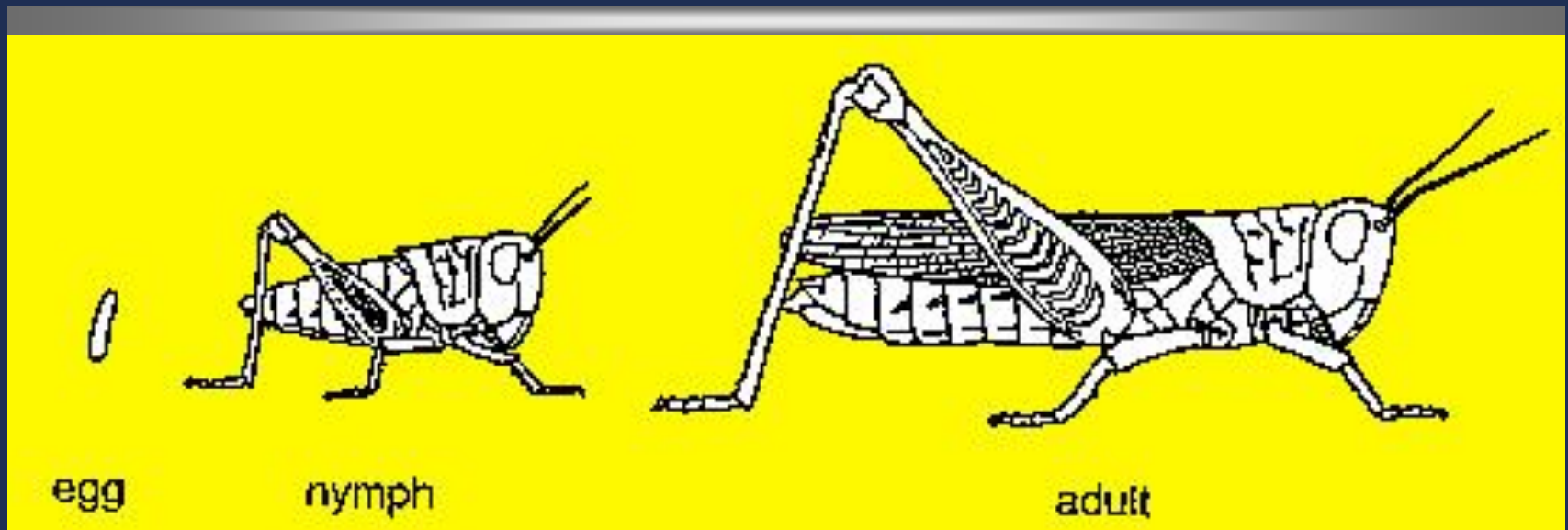
Incomplete Metamorphosis



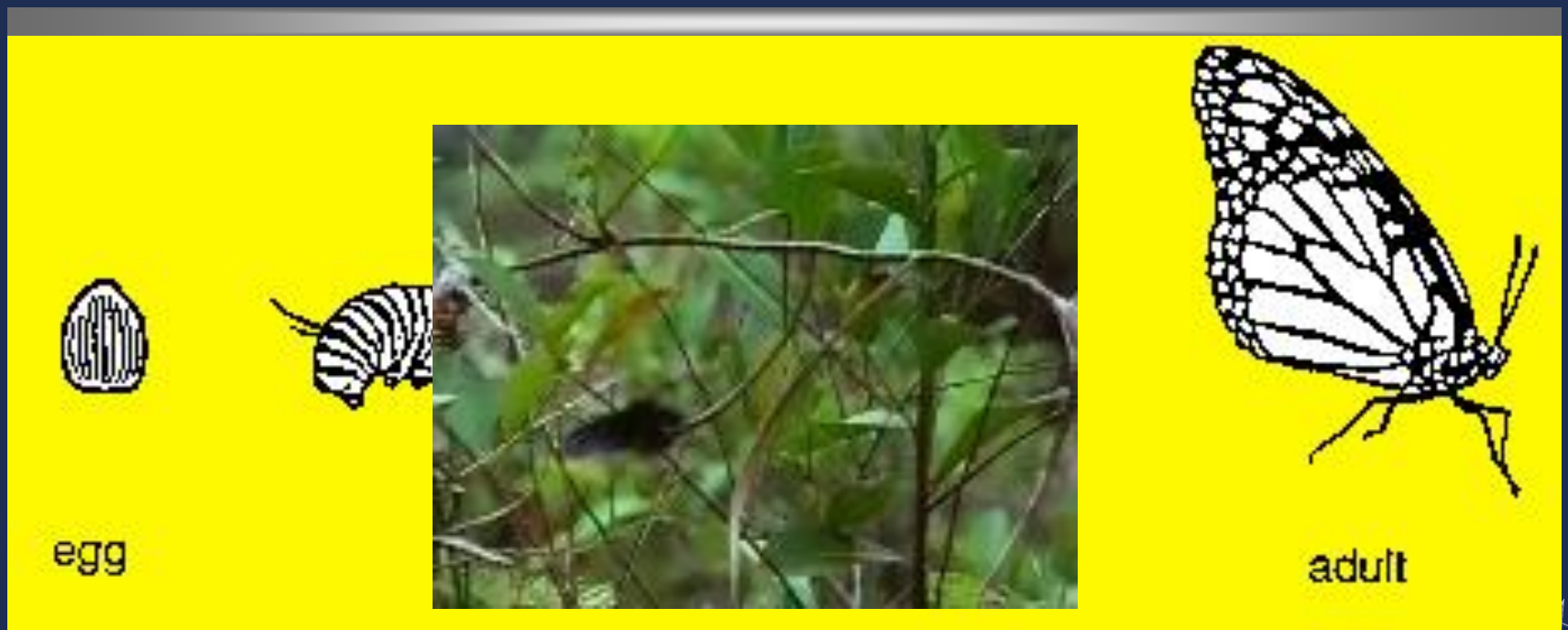
ODONATA, EMPHEMEROPTERA

Simple Metamorphosis

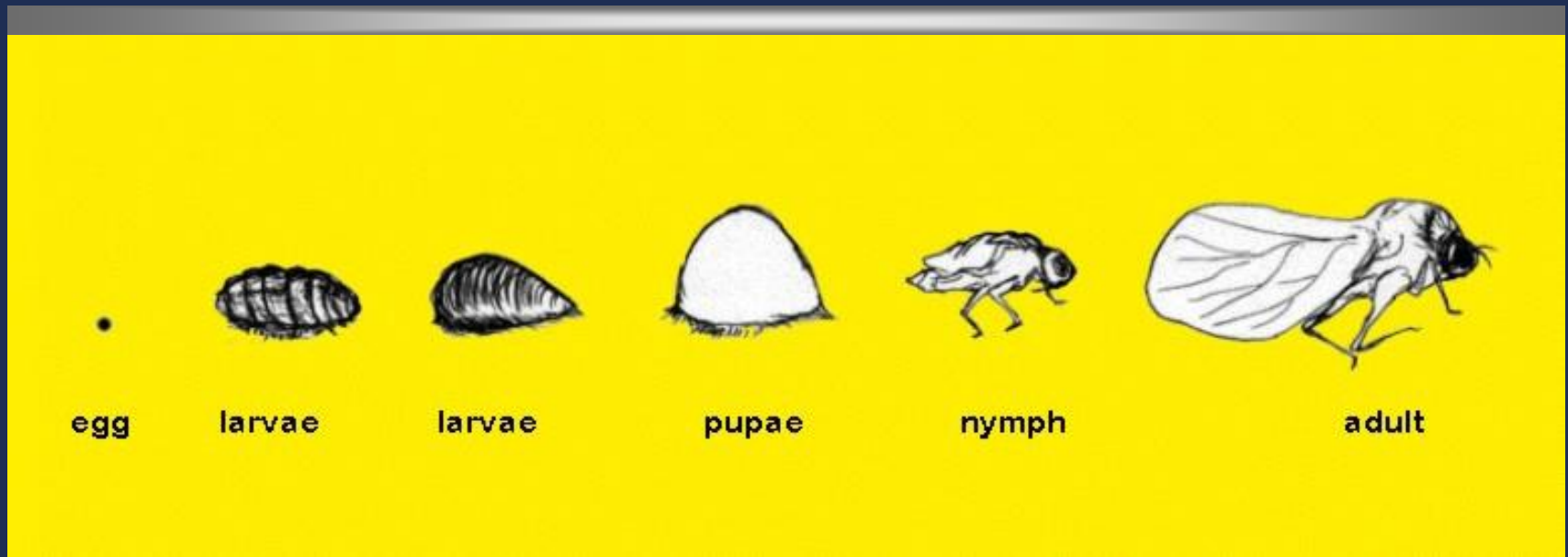
Gradual Metamorphosis



Complete Metamorphosis



Intermediary Metamorphosis





How Insects Grow

⊗ METAMORPHOSIS

⊗ Molting or “ecdysis”

*Shedding the old skin or
“exuvium”*





How Insects Grow

⊗ METAMORPHOSIS

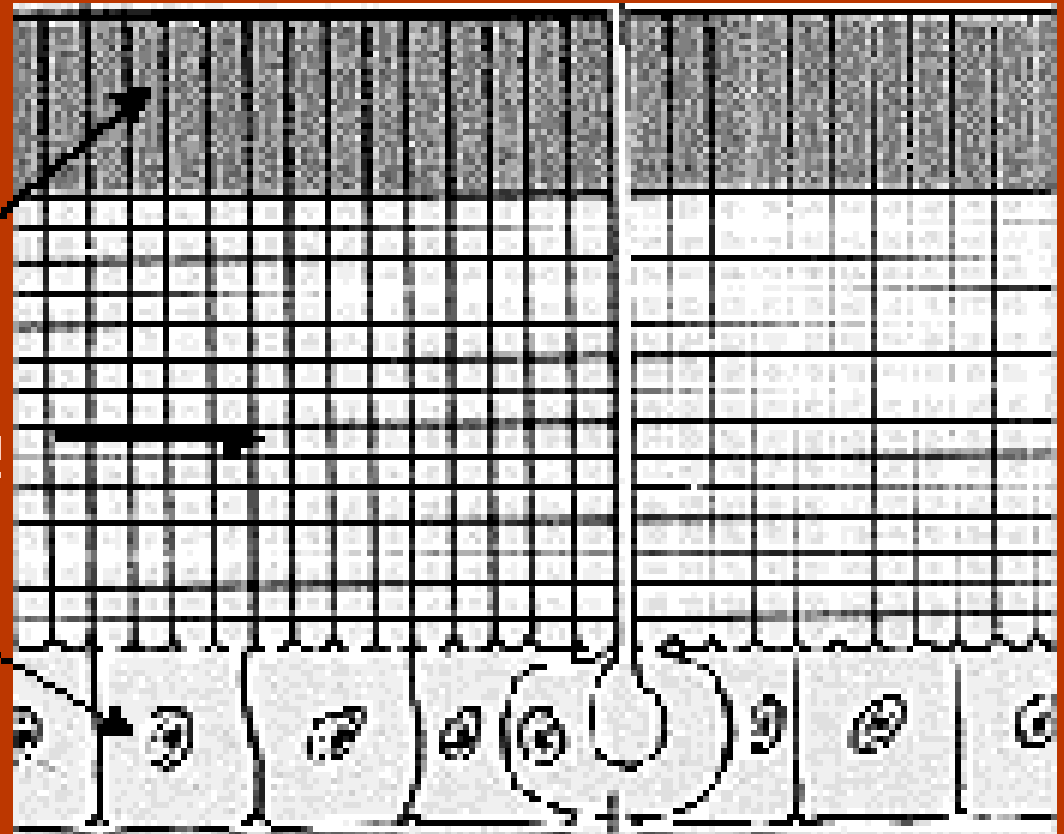
⊗ Molting or “ecdysis”

*Shedding the old skin or
“exuvium”*



Section of Cuticle

- Epicuticle
- Exocuticle
- Endocuticle
- Epidermis



- Basement membrane

1

Stages in Molting

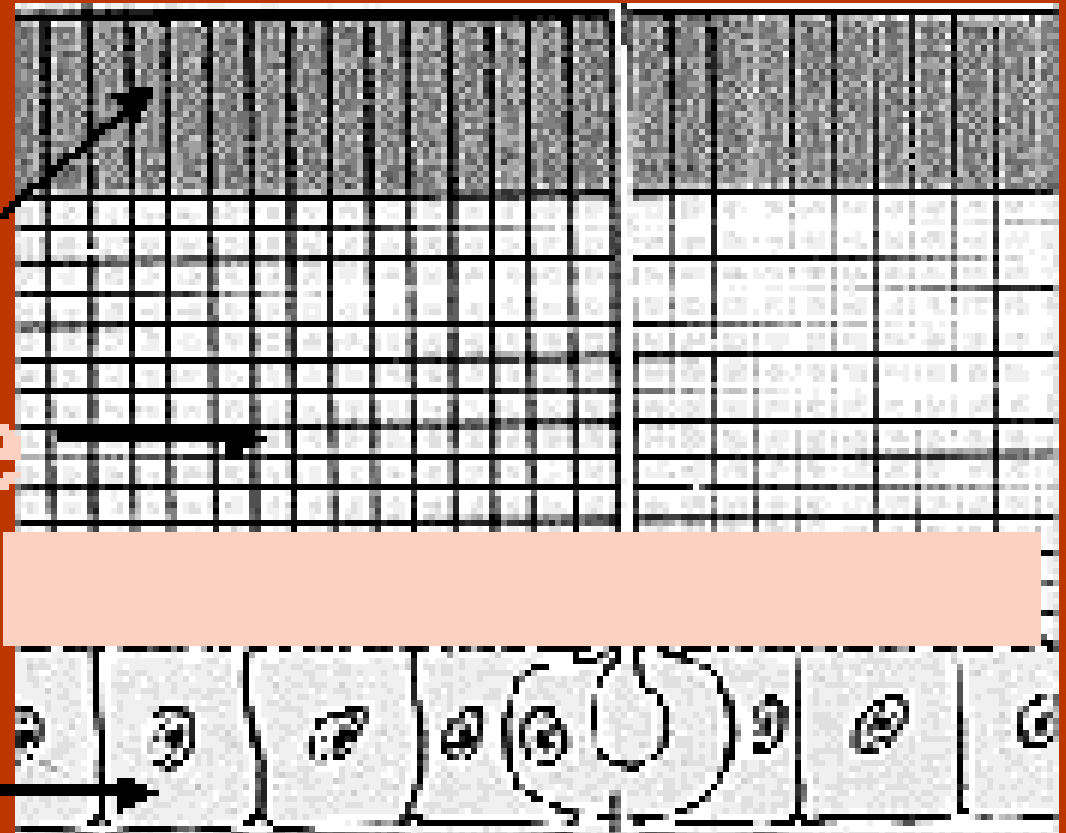
Apolysis

cuticle separates from
epidermal layer and molting
gel deposited



Section of Cuticle

- Epicuticle
- Exocuticle
- Endocuticle
- Molting gel
- Epidermis
- Basement membrane



2

Stages in Molting

New epicuticle forms
below molting gel



Section of Cuticle

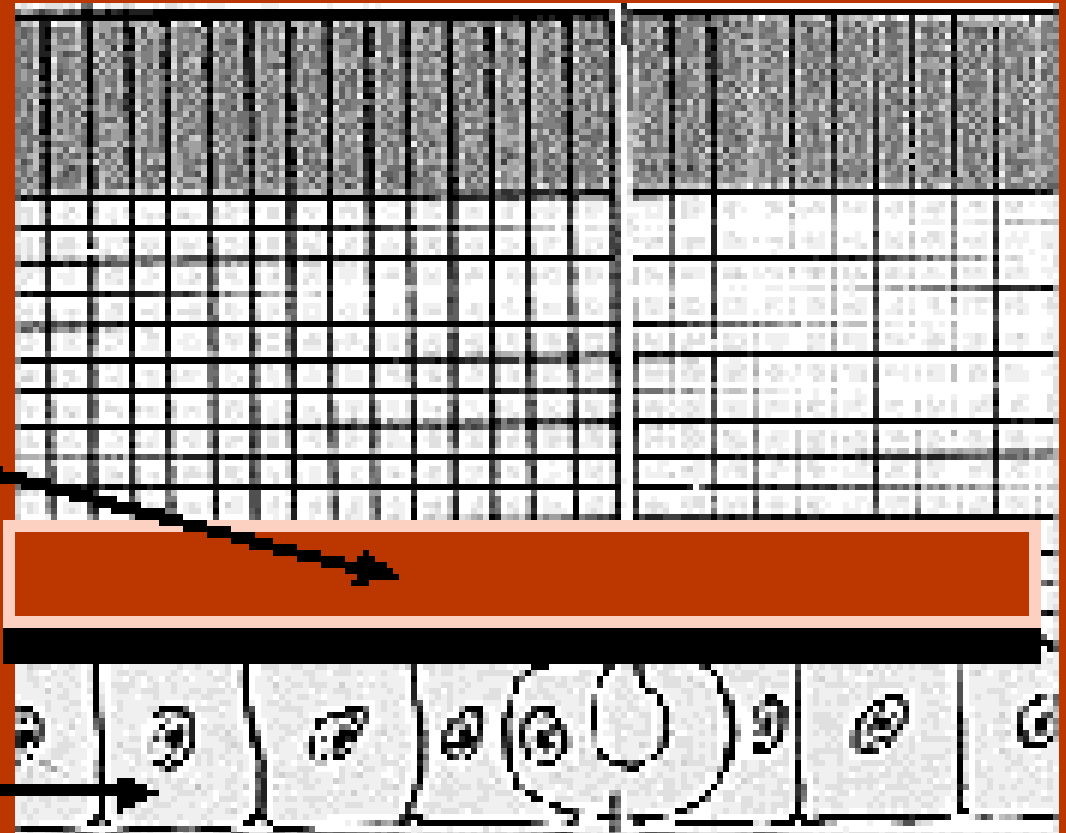
- Epicuticle

- Molting gel
activates

- Epicuticle


- Epidermis

- Basement membrane





Endocrine Control of Molting

- **PTTH “prothoracicotropic hormone” stimulates the prothoracic gland to release molting hormone (ecdysone)**
 - **Ecdysone activates**
 - Apolysis
 - New epicuticle and procuticle deposition
- 

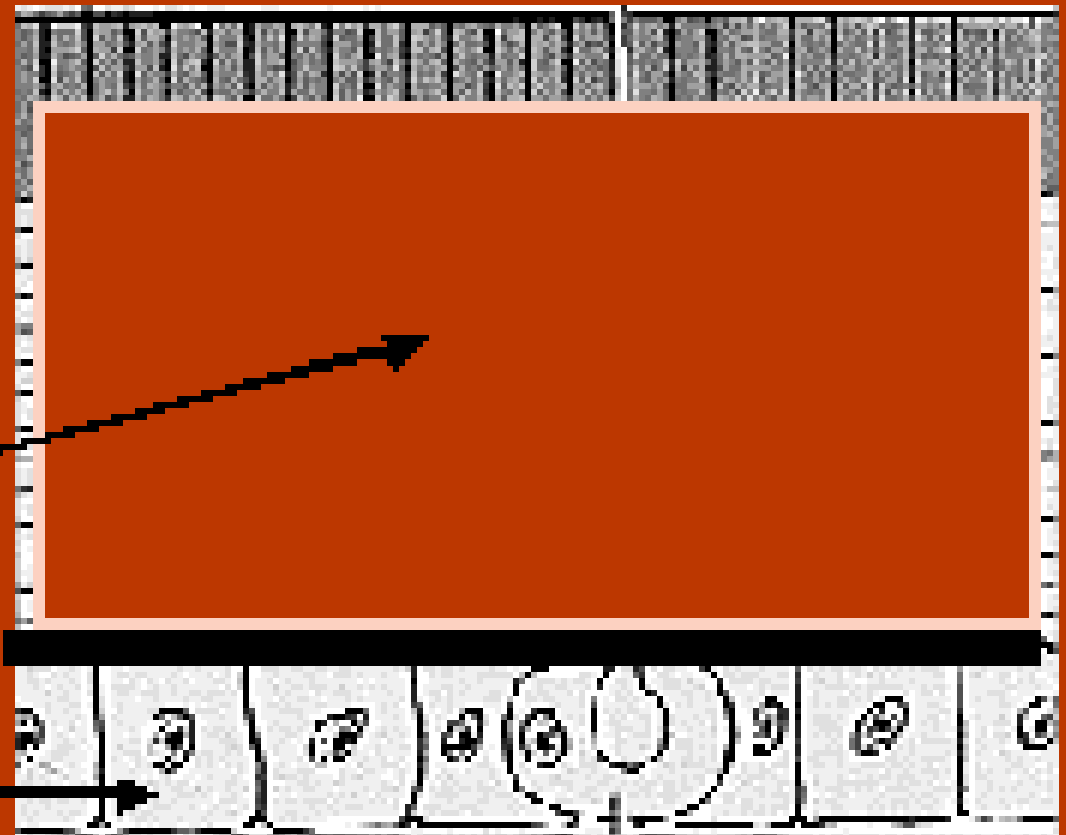
3

Stages in Molting

Molting gel is activated
and digests old
procuticle

Section of Cuticle

- Epicuticle
- Procuticle
digested
- Epicuticle
- Epidermis



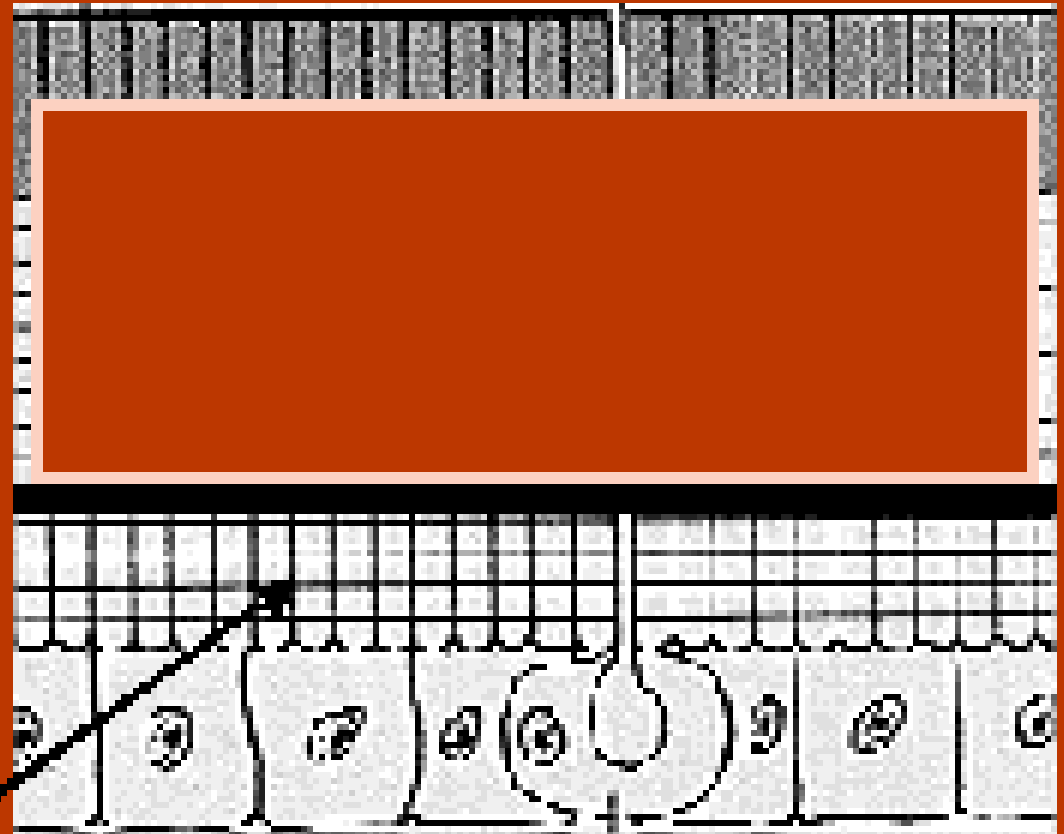
4

Stages in Molting

New soft procuticle
forms under new
epicuticle

Section of Cuticle

- Old epicuticle
- New epicuticle
- New procuticle



5

Stages in Molting

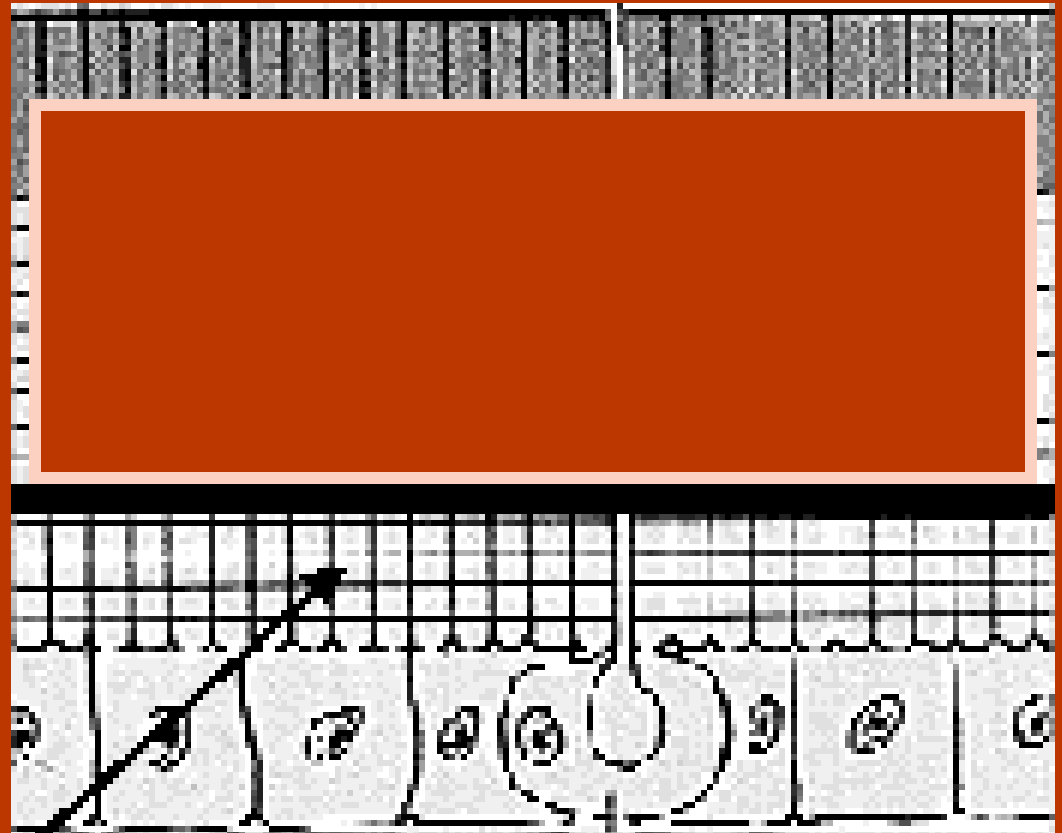
Ecdysis

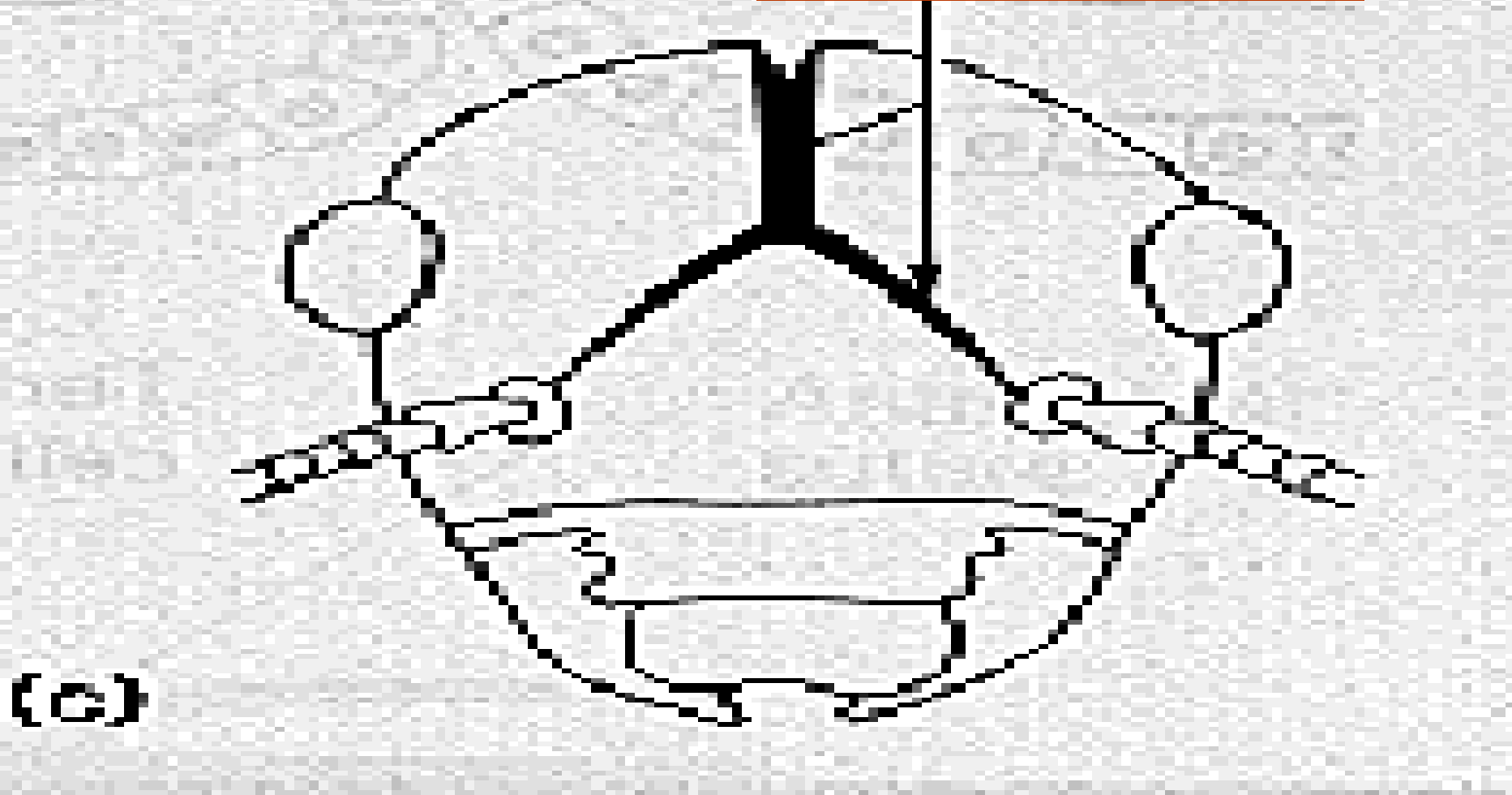
“old skin is shed”



Section of Cuticle

- Old epicuticle
- New epicuticle
- New procuticle





Larvae of Lepidoptera (Molting Process)



E
c
d
y
s
i
s





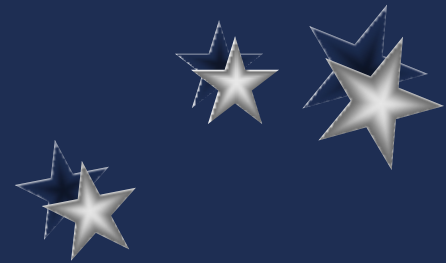
Endocrine Control of Molting

- **Ecdysion hormone** from brain stored in corpora cardiaca, when released, acts on the ventral nerve cord

- **Ecdysion hormone activates :**

- **Ecdysis**

“Shedding the old skin”



6

Stages in Molting

Expansion

“growth occurs”

New procuticle





Three Phases of Insect Development

- Embryo
- **Immature**
- Adult / Imago





Three Phases of Insect Development

- Embryo
- Immature
- **Adult / Imago**



7

Stages in Molting

Hardening and Tanning
Endocuticle deposition

Cicada (Molting Process) Immature to Adult



M
o
t
a
m
r
o
p
h
o
s
i
s





Endocrine Control of Molting

- **Bursicon**, also released from the brain, stimulates :
 - Cuticle expansion
 - Hardening and darkening
 - Endocuticle deposition

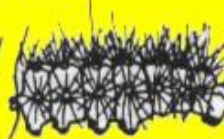
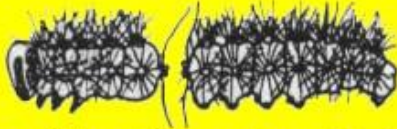


Intact caterpillar



Pupates

Caterpillar ligated at 7 days



Front half pupates

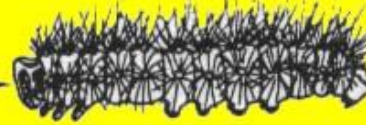
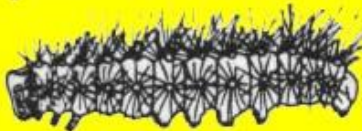
Back half remains larval

Caterpillar ligated at 10 days



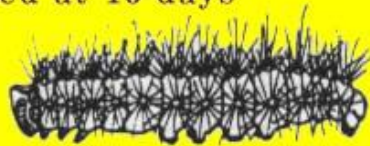
Both halves pupate

Caterpillar debrained at 7 days

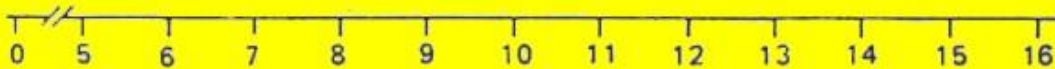


Remains larval

Caterpillar debrained at 10 days

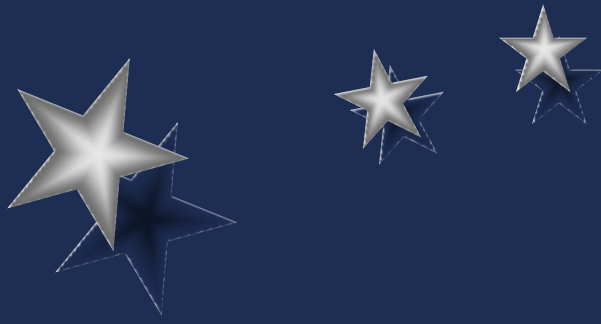


Pupates



DAYS OF INSTAR

Stefan Kopeck



SUMMARY

Hormonal Signal

Molting Event

PTTH



Ecdysone



1. Apolysis
2. Epicuticle deposition
3. Procuticle deposition



Eclosion Hormone



4. Ecdysis



Bursicon



5. Cuticle Expansion
6. Hardening & Darkening
7. Endocuticle deposition





Terima Kasih

ATUPUS

Prepared
by
Suput@

