

2026 ENTOMOLOGY (B/C) – TRAINING HANDOUT

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National Rules Committee Chairman – Life Science

DISCLAIMER - The rules which will be in your Coaches Manual and Student Manuals will be the official rules.

- **BE SURE TO CHECK THE 2026 EVENT RULES** for EVENT PARAMETERS.
- **THE NATIONAL INSECT LIST** may be found at www.soinc.org under Event Information.

TRAINING MATERIALS:

- **Training Power Point** presents an overview of material in the training handout
- **Training Handout** presents introductory topic content information for the event
- **Sample Tournament** has sample problems with key
- **Event Supervisor Guide** has event preparation tips, setup needs and scoring tips
- **Internet Resource & Training Materials** are available on the Science Olympiad website at www.soinc.org under Event Information.
- The Insects of North America Princeton Field Guide (2023) can be purchased online.
- **Division B and Division C Test Packets** are available from SO store at www.soinc.org

THE COMPETITION:

- 26 Orders, 1 Subclass and 100 Families (B & C)
- **2026 Official National Insect List** is based upon the Insects of North America Princeton Field Guide (2023). **Note:** Since taxonomic schemes may vary greatly from source to source, the Science Olympiad Official Insect List will be used for all competitions and all arbitration questions will defer to the Princeton Field Guide.
- This national insect order/family is available on the Official Science Olympiad webpage at www.soinc.org, as well as training materials, and web resources.
- Identify insects and selected immature forms by Order and Family and common name
- Not more than 50% of the questions should require identification. Most of the questions will require a student to apply knowledge of the organism based upon identification.
- Specimens or images (nymph or larva for selected orders and families) will be exhibited – usually as stations.
- Topics may include structure and function of internal and external anatomy, ecology, behavior & history.
- For any *individual specimen*, questions may also concern economic or health impact of specimens on humans. Questions may also focus on general ecological relationships of individual specimens with other plants and animals, i.e., competition.
- Management questions may pertain to pest/disease/invasive species concerns, Integrated Pest Management (IPM), conservation, or urban entomology.
- One of the parts of the exam may involve using or formulating a simple dichotomous key to identify insects.

Process Skills: observation, inferences, data and diagram analysis, making and/or using a dichotomous key on insects

INSECT TAXONOMY

Kingdom – Animalia

Phylum – Arthropoda

Subphylum – Mandibulata

Superclass – Hexapoda

Class Entognatha

Class – Insecta

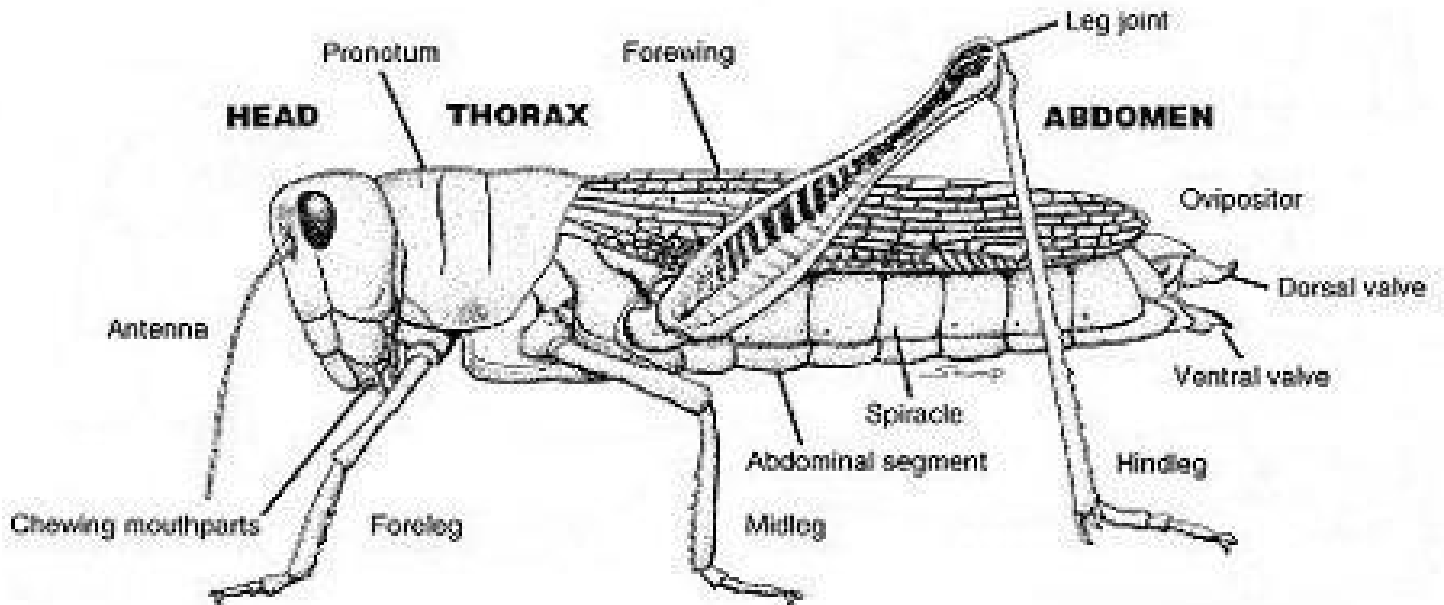
Subclass Acari

27 COMMON GROUPS OF INSECTS AND CLOSE RELATIVES

- | | |
|--|---------------------------------------|
| A. Protura (telsontails, proturans) | O. Hemiptera (true bugs) |
| B. Diptera (diplurans) | P. Thysanoptera (thrips) |
| C. Archaeognatha (bristletails) | Q. Megaloptera (dobsonflies) |
| D. Archaeognatha (bristletails) | R. Neuroptera (lacewings, antlions) |
| E. Ephemeroptera (mayflies) | S. Coleoptera (beetles) |
| F. Odonata (dragon/damselflies) | T. Mecoptera (scorpionflies) |
| G. Blattodea (cockroaches, termites) | U. Raphidioptera (snakeflies) |
| H. Mantodea (mantids) | V. Siphonaptera (fleas) |
| I. Embipectera (web-spinners) | W. Diptera (true flies) |
| J. Dermaptera (earwigs) | X. Trichoptera (caddisflies) |
| K. Plecoptera (stoneflies) | Y. Lepidoptera (moths, butterflies) |
| L. Orthoptera (crickets, grasshoppers) | Z. Hymenoptera (ants, bees, wasps) |
| M. Phasmatodea (walking sticks) | AA. Non-Insect Subclass Acari (ticks) |
| N. Psocoptera (booklice & barklice) | |

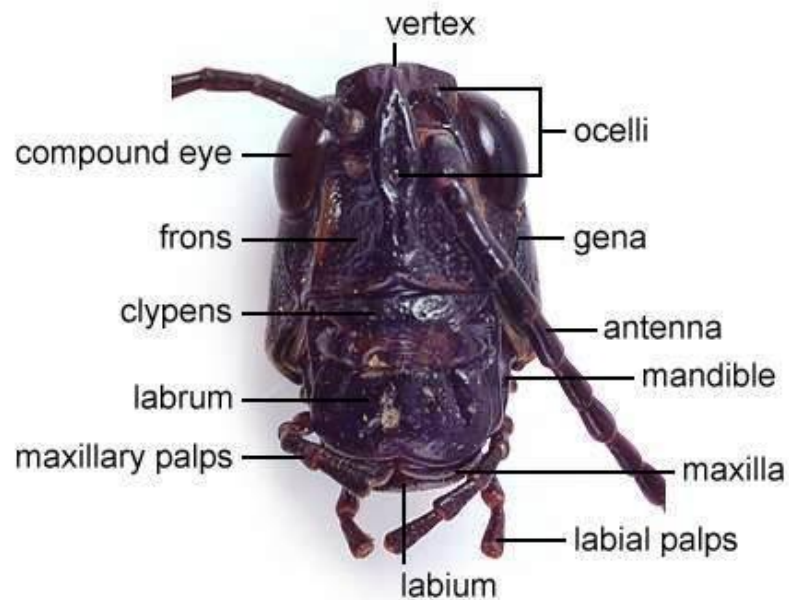
EXTERNAL ANATOMY

- Segmented body is divided into three sections: head, thorax, abdomen.
- Mouthparts may include mandibles. Often specialized (see following section on this)
- Three pairs of legs attached to the thorax.
- One pair of antennae.
- External skeleton (exoskeleton)
- Usually, one or two pairs of wings attached to the thorax as adults



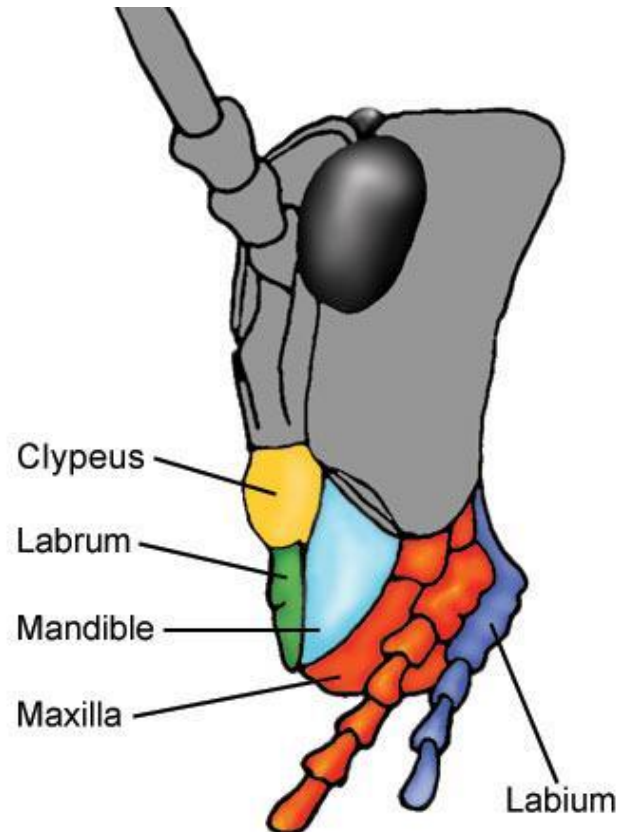
EYES – Compound and Simple (Ocelli)

Grasshopper - Frontal View of Head



MOUTH

PARTS - Labrum, Labium, Mandible, Maxilla



Specialized for: Chewing, Sponging, Piercing, Sucking, Siphoning

Insect Mouthparts



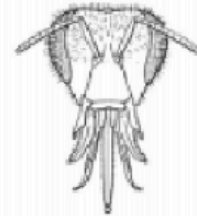
Chewing

Grasshopper



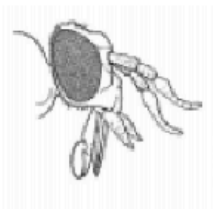
Sucking/Mouth Hooks

Maggot



Chewing/Lapping

Bee



Piercing/Sponging

Biting Fly



Rasping/Sucking

Thrips



Siphoning

Moth



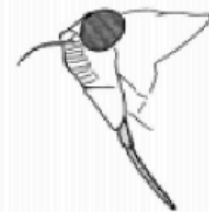
Piercing/Sucking

Mosquito



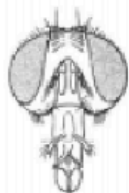
Chewing

Beetle



Piercing/Sucking

Cicada



Sponging

House Fly



Piercing/Sucking

Flea



Chewing/Raptorial

Dragonfly

Subclasses and Divisions of Insects: based on metamorphosis

Apterygota – adults like immature without wings (See Figure 1)

Pterygota – adults have wings

Exopterygota -the wings develop externally on the nymph body

Endopterygota – wings develop inside of body in immature insects and not visible until adult emerges from pupa

METAMORPHOSIS

Ametabolous–Without Metamorphosis

- The insect resembles the adult, except that it is smaller (Figure 1). Sometimes called simple metamorphosis.
- Development involves increasing the insect's size by going through successive molts.



Figure 1

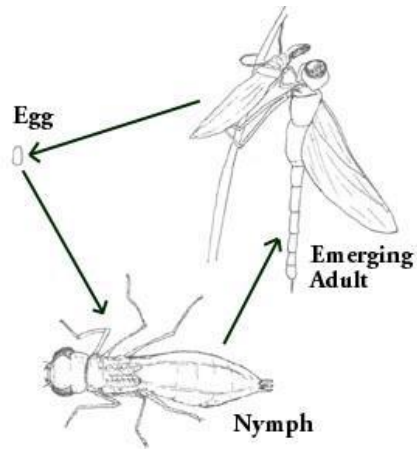


Figure 2a and 2b

Hemimetabolous – Incomplete Metamorphosis

- Stages= Egg, nymph, adult (see figure 2a)
- Also **Exopterygota** -winged insects, the wings develop externally on the nymph body (Figure 2b)

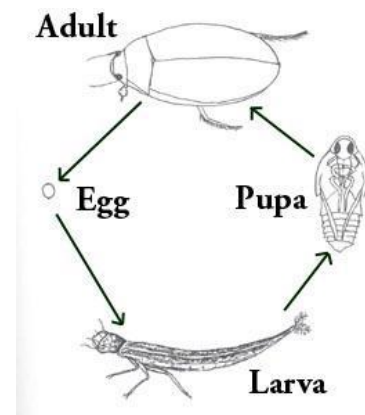
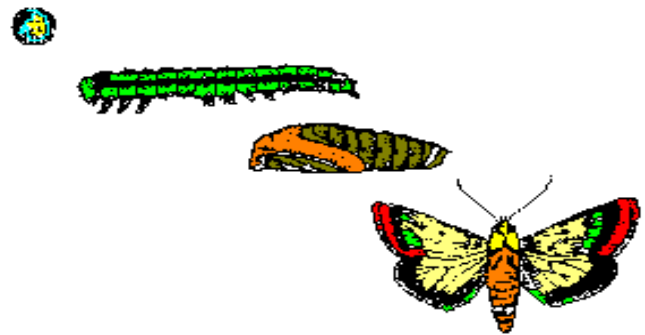


Figure 3a and 3b

Holometabolous–Complete Metamorphosis

- Egg, larva, pupa, adult (Figure 3a)



- Also **Endopterygote** – wings develop inside of body in immature insects and not visible until adult emerges from pupa (Figure 3b)

Orders - Ametabola & Apterygota

- Protura (telson tails, proturans)
- Dipula (diplurans)
- Collembola (springtails, snow fleas)
- Zygentoma (silverfish, firebrats)

Orders- Hemimetabola & Exopterygota

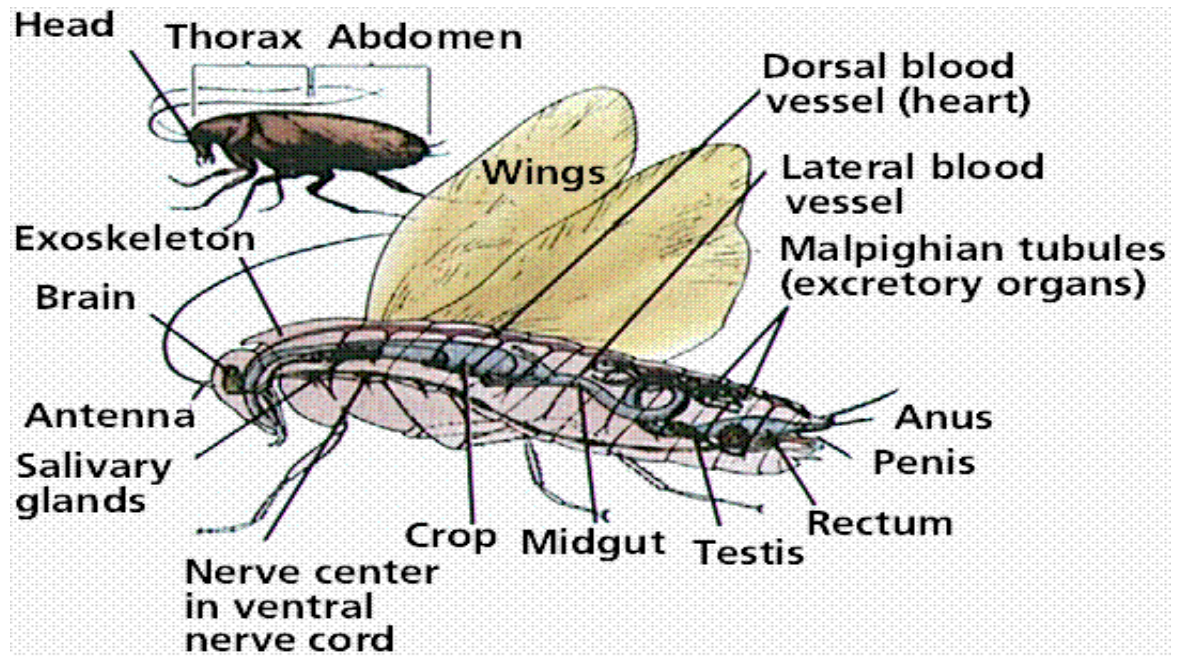
- Ephemeroptera (mayflies)
- Odonata (dragonflies, damselflies)
- Blattodea (cockroaches, termites)
- Mantodea (mantids)
- Embiptera (webspinners)
- Dermaptera (earwigs)
- Plecoptera (stoneflies)
- Orthoptera (crickets, grasshoppers)
- Phasmata (walking sticks)
- Psocoptera (book and bark louse)
- Thysanoptera (thrips)
- Hemiptera (true bugs)

Orders-Holometabola & Endopterygota

- Megaloptera (dobsonflies)
- Neuroptera (lacewings, antlions)
- Coleoptera (beetles)
- Strepsiptera (twisted-wing parasite)
- Mecoptera (scorpionflies)
- Siphonaptera (fleas)
- Diptera (true flies)
- Trichoptera (caddisflies)
- Lepidoptera (butterflies, moths)
- Hymenoptera (ants, bees, wasps)

Subclass Acari- Ticks

Family Ixodidae- Hardbacked Ticks



INSECT ECOLOGY:

BENEFICIAL INSECTS:

- Pollination of many flowering plants
- Decomposition of organic materials
- Recycling of carbon, nitrogen, and other essential nutrients
- Control of populations of harmful invertebrates including other insects
- Direct production of foods as honey
- Manufacture of products as silk

INSECT PESTS:

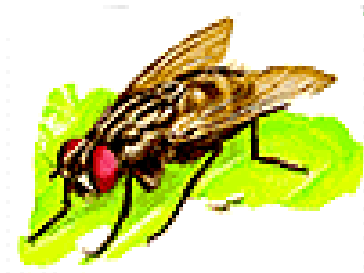
- Damage Crops
- Household Pests
- Parasites
- Biting and Stinging Insects
- Prey on domestic animals
- Eat human food, clothing & possessions
- Destroy trees, wood, paper

DISEASE RELATED INSECTS:

- Mosquitoes – malaria, arboviral encephalitis, dengue fever, Rift Valley fever, West Nile encephalitis viral infection
- Ticks – Lyme disease, Rocky mountain spotted fever, tick typhus
- Fleas - plague
- Lice – lice infestation

Constructing A Dichotomous Key

Four insects: a ladybug, a grasshopper, a dragonfly and a housefly.



- A. Start by observing the group of things to be used in the key.
- B. List the most general traits that can be used to divide the organisms into categories.
- C. Now, use your characteristics to fill in the Dichotomous Key below

Dichotomous Key

- | | |
|----|---------|
| 1. | go to 2 |
| 1. | go to 3 |
| 2. | |
| 2. | |
| 3. | |
| 3. | |

Notice that there were four organisms to be identified and it only takes three steps. There should be one less step than the total number of organisms to be identified in your dichotomous key.

TIPS FOR COLLECTING AND PRESERVING INSECTS

Collecting:

- Most adult flying insects are generally collected using a net.
- Individual insects can be collected with forceps by searching on plants, under logs and rocks and among weeds.

Killing:

- Most entomologists use "killing jars" to kill the insects they have collected.
- A simple version of this is essentially a wide mouthed jar with a small open vial containing cotton attached to the lid.
- The cotton is saturated with **fingernail polish remover** which is relatively safe, but the killing jar should be labeled **KILLING JAR--POISON**.
- Specimens should be removed from killing jars as soon as possible and never more than a few hours.
- Insects can also be placed in vials or jars and placed in the freezer for several days.
- This will kill most insects although a few may revive when thawed.

Mounting and Preserving:

- Most insects, unless very small or fleshy larvae, are best preserved by pinning and drying.
- Use only specially made insect pins to mount insects and pay attention to the location of the pin through the animal.
- Butterflies, moths and dragonflies will need to be spread on a pinning board to arrange their wings and legs and antennae.
- Very small insects may need to be attached with glue or nail polish to small triangles of stiff paper which are then inserted onto insect pins.
- If you are making a collection of insects you must keep them in an insect proof box or tray.
- It is a good idea to place a moth ball in the box to prevent destruction by insects.
- See "Collecting and Preserving Insects" Handout for more details and resources.

PREPARING FOR COMPETITION

Field Guide

- Study the organization of the field guide
- Study the information in the front of the field guide
- Become familiar with the organization of the color plates in the field guide
- Notice how the field guide organization is similar to the organization of the Official Insect List
- Put the page numbers of Orders and Families Information from the Insects of North America Princeton Field Guide on the Official Insect List – it will save you a lot of time
- Tab the field guide with very small useful tabs so it is not cluttered and can be easily used
- Notice how the Order Characteristics come first and then the Family characteristics come
- Practice using the Field Guide to identify specimens or photos
- Practice under timed conditions to prepare for competition

Study Binder - Use the Binder to Help Learn the Insects !!!!!

- The most effective resources are the ones produced by the students.
- The process of producing the resources is a major learning tool.
- Have a copy of the rules in your binder
- Have a copy of the lists (insects) in your binder
- Prepare and organize materials by major topic divisions.
- Place materials from many different sources into your topic divisions
- Reduce the size of pictures where possible to get more information on a page.
- Color code information to help you locate or emphasize key items.
- Put pages in sheet protectors – two per protector to save space.
- Use tabs to separate sections.
- Label tabs so items can be located with ease.

Power Point Slides - make power point slides for insects and use them to study

Flash Cards – make a set of flashcards with pictures on the front and information on the back

Actual Specimens – collect and preserve actual specimens of insects – put data card with them so you can use them for study.

Timer – prepare practice stations and use the timer to improve efficiency of your teamwork skills

PREPARING RESOURCE PAGES TO TAKE INTO THE COMPETITION

- **Learn the insects so resources will be used as little as possible.**
- **The most successful teams use very limited resources in competition.**
- You will probably want to include the official insect list – put field guide page numbers on it to save time
- Place other notes that are not in the field guide
- Use notes for material you want to use that is not in the Field Guide or on the Official Insect List
Check the event parameters, so you know what is allowed in the competition.
- Since the events are timed, organization of materials is essential for the most effective use of the materials during the competition.
- Organize materials on each page to maximize available space
- Cut and paste items to organize materials more effectively on a page.
- Color code information to help you locate or emphasize key items.
- Use front and back of the page.
- Place the page in a protective sleeve or laminate it so it won't get wet or damaged.

DOING THE COMPETITION

General Tips

- Insect specimens may look different from photos of an insect – the color & texture may change with drying. Be careful to protect actual specimens so they will not be damaged
- Try to identify the specimen to the Order and then decide what Family it is where needed
- Use common sense when answering non- identification questions
- Be careful to spell Order, Family and Common Names correctly
- Work as a team and use your teamwork skills to finish the requested tasks

Answer Sheet

- Be sure to put your team name, team number, and individual team member names.
- Print information so it can be easily read and understood.
- Place answers in the appropriate place on the answer sheet.
- Be sure to put units after any measurements or calculations.
- Be sure answers to essay questions are organized and easy to read.

Team work skills

- Use time effectively! Assign tasks and trust your partner's skills.
- Keep on task and be sure to finish each part of the assigned question.

Answering questions

- Carefully read all questions to determine exactly what is being asked.
- Take a moment to determine if your answer makes sense.
- Be certain that you have completely answered each question.
- Pay attention to details in the questions and in your answers.

GOOD LUCK! Have fun and do your best.