Guide

This part of the document will contain an explanation to most of the questions asked on the test.

Section 1: Identification

This section is a MAJOR part of succeeding in Entomology. A large portion of this event is dedicated to identifying insects correctly. In most cases, if you do not identify an insect correctly, you may end up missing an entire station worth of questions.

Part 1: Distinguishing Between Tricky Taxons

This part of the test, needless to say, is very difficult. It can involve deciphering minute differences between two insects in order to determine which taxonomic group they happen to belong to.

When writing this test, I picked taxons that I often had difficulty determining differences between. The colors are used to indicate "groups" (for example, I often had trouble telling **Diplura** from **Protura**, **Anoplura** from **Mallophaga**, etc). In the following section of this guide, we will take a look at some of the distinguishing differences between members of each group. Each group will have a brief explanation of the differentiating traits, along with a table for convenience (if necessary).

Group 1: Diplura vs Protura

1. Diplura
2. Protura

This was one of the easiest in this section once you know two distinguishing differences. First of all, **Diplura** has long, beadlike antennae, whereas **Protura** has vestigial (if any) antennae. Additionally, in some cases, **Diplura** has two "tails" projecting off the back of the abdomen (hence the name "Di" "plura"). However, these are not always present and are therefore a less reliable method of distinction.

	Diplura	**Protura**
Cerci	Beadlike or pincer-like	None
Antennae	Long and beadlike	None

Group 2: Anoplura vs Mallophaga

3. Anoplura
4. Mallophaga
5. Mallophaga
6. Mallophaga

Anoplura vs **Mallophaga** is something I never managed to fully figure out. The main difference I found – which is true MOST of the time – is that **Anoplura** possesses very pronounced "claws". Also, **Mallophga's** head is much larger in proportion to the rest of its body.

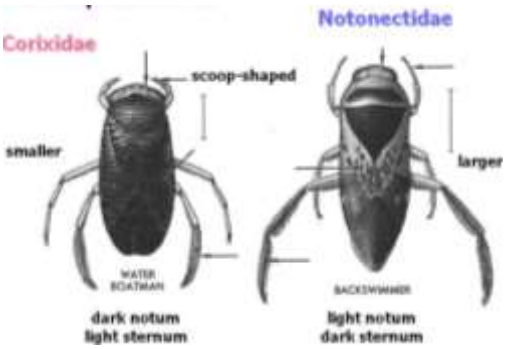
	Mallophaga	**Anoplura**
Claws	Not visible	Visible

Head	Very large in proportion to body	Small compared to rest of body

Group 3: Notonectidae vs Corixidae

7. Corixidae
8. Notonectidae
9. Notonectidae
10. Corixidae
11. Notonectidae

A simple picture is sufficient here: (if you have space, put this on your cheat sheet. Or at least write the differences into your field guide)



Differences shown in picture:

	Notonectidae	Corixidae
"Top" is _____-colored.	Light	Dark
Legs	Fringed legs	Scoop-legs

Group 4: Nepidae vs Belostomatidae

12. Nepidae
13. Nepidae
14. Belostomatidae
15. Nepidae

General Note (to provide clarification for the paragraph below):

- Some **Nepidae** are skinny. Some are fat.
- Male **Belostomatidaes** have eggs on their back. Females do not.
- Bottom Line: it is USUALLY easy to distinguish between the two taxons, however..

This one is pretty easy if the **Belostomatidae** is a male AND the **Nepidae** is a 'skinnier' one. However, if the **Belostomatidae** is female, it can resemble the "fatter" form of a **Nepidae**. Basically, **Belostomatidae** will NOT have any abdominal projections. **Nepidae** will. (In some rare cases, **Belostomatidae** will have a very small dorsal abdominal projection, but this is rare. If it is the case, **Nepidae**'s dorsal abdominal projection will be much longer.) Additionally, **Belostomatidae**'s eyes are larger than **Nepidae**'s eyes.

	Belostomatidae	Nepidae
Abdominal Projection	Very small if present	Long and skinny
Eyes	Larger	Smaller

Group 5: Miridae vs Lygaeidae vs Coreidae

16. Miridae
17. Lygaeidae
18. Coreidae
19. Miridae
20. Coreidae

Our first group of three on the test. Here, we're looking at **Miridae** vs **Lygaeidae** vs **Coreidae**. I found this one to be very annoying, to say the least. Basically, **Coreidae** is the odd man out here. He's pretty easy to distinguish from the other two because he (sometimes) has very enlarged hind legs. Additionally, he has a distinctive prothorax (the thing that's like a neck, located between the rest of the body and the head).

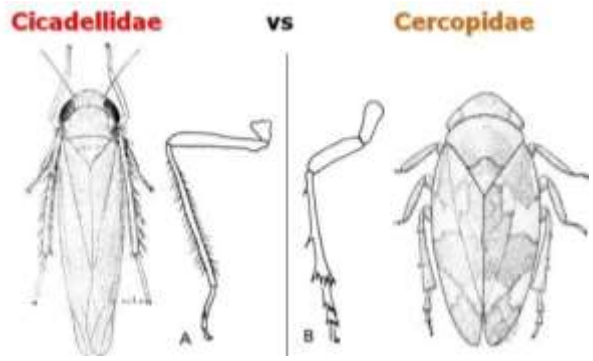
Now we're down to **Miridae** vs **Lygaeidae**. First of all, if a bug is black and dark red/orange, it's probably a **Lygaeidae**. (there are exceptions, of course). The more reliable of the differences is the presence of a *cuneus* in **Miridae**. The cuneus is the thing at the back end of the wings that "folds" down. It's basically a crease in the wings. **Lygaeidae** does not have this.

	Miridae	Lygaeidae
Cuneus	Yes	No
Coloration (use only as last resort for ID'ing between the two)	Variable	If it's black/red, it's probably a Lygaeidae.
Ocelli	No	Yes

Group 6: Cercopidae vs Cicadellidae

21. Cercopidae
22. Cicadellidae
23. Cercopidae
24. Cercopidae

Another extremely annoying group of two families that is very hard to distinguish…Let's look at body shape first. *Generally speaking*, **Cercopidae** has a less elongated shape. However, this is not always true. The best way to differentiate is probably the row of spines on **Cicadellidae**'s hind leg. **Cercopidae** only has 1-2 spines, while **Cicadellidae** has an entire row. The following picture sums things up pretty well:



Group 6: Lestidae vs Coenagrionidae

25. Lestidae
26. Lestidae
27. Coenagrionidae

28. Lestidae
29. Coenagrionidae

There's really one main difference here: **Lestidae** rests with wings open, while **Coenagionidae** rests with wings closed. Also, **Lestidae**'s eyes tend to be more offset from the head. Finally, look at wing venation diagrams if you are having more trouble.

	Lestidae	**Coenagrionidae**
Wings rest	Open	Closed
Eyes	Greatly offset from head	Less offset from head

Group 7: Gomphidae vs Libellulidae vs Aeschnidae

30. Gomphidae
31. Gomphidae
32. Libellulidae
33. Aeschnidae
34. Aeschnidae
35. Libellulidae
36. Gomphidae

Here, we have our dragonflies. Basically, **Gomphidae** is the odd man out here because their *eyes are separated*. Taxonomically speaking, this is really what separates **Gomphidae** from **Aeschnidae** and **Libellulidae**, NOT the 'club' at the end of the abdomen. This club is NOT present in all members of the **Gomphidae** family, and may be present in members of other Odonatan families.

Now, we're left with **Aeschnidae** and **Libellulidae**. **Libeullulidae** usually has a shorter, stouter body than **Aeschnidae**. Also, its wings are more likely to be very patterned than **Aeschnidae's** wings. **Libeullidae's** eyes touch *slightly* less than **Aeschnidae's** eyes.

	Aeschnidae	**Libellulidae**
Wings	Not very boldly patterned	*CAN* be more boldly patterned
Body	Long and skinnier	Short(er) and stouter
Eyes	Touch slightly more	Touch slightly less

Group 8: Gryllidae vs Gryllarcididae

37. Gryllidae
38. Gryllacrididae
39. Gryllacrididae
40. Gryllidae
41. Gryllacrididae

This one really isn't too hard. **Gryllarcididae** is usually brightly colored (yellow, orange, etc), while **Gryllidae** is almost always black or brown. Although color is usually not a good way to ID insects, it works in this case. Additionally, **Gryllidae** has bigger spines on its leg than **Gryllarcididae**.

	Gryllidae	**Gryllarcididae**
Color	Black or brown	Yellow or orange-ish

Leg Spines	Bigger spines	Smaller (but present) spines

Group 9: Culicidae vs Chironomidae

42. Culicidae
43. Culicidae
44. Chironomidae
45. Chironomidae
46. Culicidae

The major difference between Culicidae and Chironomidae is the antennae. Chironomidae has very plumose antennae, while Culicidae often does not. Additionally, Culicidae may sometimes be "striped", or somewhat "spotted" in coloration.

Group 10: Syrphidae vs Bombyliidae

47. Syrphidae
48. Syrphidae
49. Bombyliidae
50. Syrphidae
51. Bombyliidae

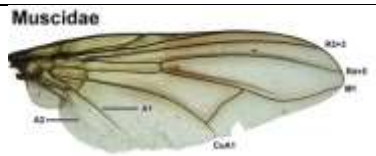
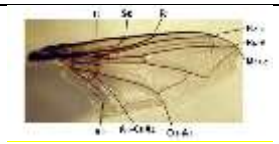
The main difference here is the presence of "hair" on **Bombyliidae**. **Syrphidae** never has "hair", while **Bombyllidae** usually does. Also, **Syrphidae's** abdomen is striped differently than **Bombyliidae's**.

Group 11: Calliphoridae vs Tachinidae vs Muscidae

52. Calliphoridae
53. Tachinidae
54. Calliphoridae
55. Tachinidae
56. Muscidae
57. Muscidae
58. Tachinidae
59. Calliphoridae

These are three of the hardest Dipteran families to distinguish between. Usually, Calliphoridae has a greenish-blue metallic coloration. **Tachinidae's** eyes tend to be smaller than Calliphoridae's or **Muscidae's** eyes. Wing venation is also a good way to distinguish the three, if you're stuck.

	Muscidae	**Tachinidae**	**Calliphoridae**
Coloration	Usually blackish (however, CAN be green-blue metallic in some cases)	Usually blackish (however, CAN be green-blue metallic in some cases)	Almost always green-blue metallic
Eye Size	Normal	Small in proportion to head and body	Normal

Wing Venation*			

*NOTE: Wing Venation Diagrams for Lepidoptera and Hymenoptera can be found in the Audubon Field Guide, however Dipteran wing venations are not in the book. A good thing to add to your notes if you struggle with certain Dipteran families.

Group 12: Asilidae vs Stratiomyidae

60. Asilidae
61. Stratiomyidae
62. Asilidae
63. Asilidae
64. Stratiomyidae
65. Stratiomyidae

There's really one main difference here: **Asilidae** has a deep depression between eyes, and **Stratiomyidae** does not. Also, **Asilidae's** abdomen usually is skinner than **Stratiomyidae's**.

Group 13: Tephritidae vs Drosophilidae

66. Tephritidae
67. Drosophilidae
68. Drosophilidae
69. Tephritidae
70. Drosophilidae

This one is fairly easy once you know the main differences- **Tephritidae** has patterned wings. **Drosophilidae** doesn't. Also, **Drosophilidae** has red eyes and **Tephritidae** doesn't.

	Drosophilidae	**Tephritidae**
Eye Color	Red	Generally not red
Wings	Usu not patterned	Patterned

Group 14: Colletidae vs Megachilidae vs Apidae

71. Colletidae
72. Megachilidae
73. Apidae
74. Halictidae
75. Apidae
76. Colletidae
77. Halictidae
78. Megachilidae

79. Apidae
80. Apidae

This is possibly one of the hardest three groups to tell differences between. If you're using the Audubon guide, there are pages in the Hymenoptera section that contain wing venation pictures for most of the families. USE THOSE. These families can be nearly impossible to tell differences between. A few hints:

- **Halictidae** is (USUALLY) metallic/green
- **Apidae** can sometimes have a yellow thing on its leg (this is known as the scopa, used for collecting pollen)
- **Apidae** can seem to be "fatter" and fuzzier than the others

Other than the above tips, wing venation is really the most reliable to tell these bees apart.

Group 13: Tenthredinidae vs Siricidae

81. Tenthredinidae
82. Siricidae
83. Siriciade
84. Tenthredinidae
85. Tenthredinidae

Sometimes, **Tenthredinidae** can look (a little bit) like an ant. It really depends on the picture. The main difference here is the presence of a "horn" in **Siricidae**. If you're really struggling, use the wing venation diagrams in the field guide.

Group 14: Lycaenidae vs Nymphalidae

86. Lycaenidae
87. Nymphalidae
88. Lycaenidae
89. Lycaenidae
90. Nymphalidae

Lycaenidae generally has some amount of blue on the wings. Occasionally, small tails are present on the back of the wings. This is usually enough to distinguish Lycaenidae from Nymphalidae, however sometimes Nymphalidae will have blue on the wings. In these cases, use the wing venation diagrams in your field guide for assistance in identification.

Group 15: Lymantriidae vs Noctuidae

91. Noctuidae
92. Lymantriidae
93. Noctuidae
94. Lymantriidae
95. Lymantriidae
96. Noctuidae

These two groups are extremely hard to distinguish from one another. I never truly figured it out, but here are some tips:

- **Lymantriidae's** wings are generally bigger
- **Lymantriidae** has plumose antennae
- **Noctuidae** has a different pattern on each pair of wings (front wings are differently patterned that hind wings)
- **Lymantriidae's** front legs can seem "furry" and pronounced

Group 16: Dytistidae vs Hydrophilidae vs Gyrinidae vs Histeridae

97. Dystiscidae
98. Gyrinidae
99. Hydrophilidae
100. Histeridae
101. Gyrinidae
102. Dytiscidae
103. Histeridae
104. Gyrinidae

	Histeridae	**Gyrinidae**	**Dytiscidae**	**Hydrophilidae**
Antennae	Elbowed w/ clubbed ends	Short, plump, clubbed	Filiform (long and thin)	Have a club
Eyes	Nothing significant here	Compound eye split (half looks up, half looks down)	Somewhat widely spaced	Don't bulge
Legs	Flattened, jointed	ML and HL for swimming (natatory), very short, flattened, and fringed with bristles || FL long & grasping, contain suckers to hold female while mating	Middle legs closer to front legs than hind legs, HL fringed and flattened	HL flattened with a fringe of hairs

Group 17: Lamphyridae vs Cantharidae

105. Lamphyridae
106. Cantharidae
107. Cantharidae
108. Lamphyridae
109. Lamphyridae
110. Cantharidae

Main difference: **Lamphyridae's** head is concealed from above by pronotum. **Cantharidae's** isn't.

Group 18: Chrysomelidae vs Coccinellidae

111. Chrysomelidae
112. Coccinellidae

113. Coccinellidae
114. Chrysomelidae
115. Coccinellidae

These two can be pretty obvious sometimes. **Coccinellidae** is almost always spotted. If you're struggling, the main difference is the antennae. **Chrysomelidae's** antennae are much shorter than **Coccinellidae's**.

Part 2: Traditional- Slides and Questions

This is the most common format for an Entomology test. Basically, there's a picture of an insect (or two), and you have to identify it. You will also have to be able to find information about them, such as habitat, diet, human impact, etc.

Very little explanation is required here. To help with these kinds of questions, I have one suggestion: http://scioly.org/wiki/index.php/Entomology/Entomology_Insect_List Go. To. This. Page. It has EVERY piece of information about EVERY taxon on the list. USE IT.

116. Megaloptera
117. Pheromones
118. No
119. Nothing
120. Rest on vegetation (are nocturnal)
121. Lepidoptera
122. Nymphalidae
123. Danaidae
124. Flat
125. Spring
126. Mantids, mice, ants, wasps, ladybirds, lacewings
127. Modified into brushes and not used for walking
128. Homoptera
129. Aphididae; Aphid (must have both)
130. Slowly, do not jump or hop
131. No, only have wings in special conditions
132. Honeydew
133. Cornicles or siphunculi
134. **Parthenogenesis**: a type of asexual reproduction in which the offspring develops from unfertilized eggs. Female aphids are parthenogenetic.
135. Mantodea; Mantids/Praying Mantis (must have both)
136. The joke is funny because the female devours the male's head after mating.
137. Catching prey
138. Short and multisegmented
139. Males are fully winged, while females have reduced/no wings
140. Homoptera
141. Dactylopiidae
142. Can't move

143. Cacti, prickly pears
144. Red
145. 3-6 generations/year
146. Female = 3; Male = 5
147. Yes
148. Diptera
149. Simuliidae
150. No
151. 11 segments
152. River blindness
153. No
154. Females
155. Sunrise and sunset
156. Grylloblattodea
157. Dermaptera
158. Brown = Male; Yellow = Female
159. Chewing
160. No
161. Yes
162. No (doesn't live with humans)
163. Incomplete (Hemimetabola)
164. Cerci; Used for grooming, mating, defense, courtship, or folding wings
165. Isoptera
166. Worker; Doesn't have prominent mandibles or wings
167. Behavior and ecology
168. Important decomposers
169. Incomplete
170. No
171. Strepsiptera
172. Male; Females don't have legs/wings
173. Sensory perception
174. No
175. Usually less than 5 hours
176. Fan-like
177. .5-4mm
178. Mecoptera
179. Boreidae
180. Panorpidae
181. No
182. Dead/dying insects
183. Rostrum
184. B
185. 2
186. No, not abundant enough to have any impact

187. Neuroptera; Chrysopidae
188. Neuroptera; Myrmeleontidae
189. Adult
190. Larva
191. No
192. Threadlike/ Filiform
193. In grass & weeds & on tree/shrub foliage
194. Arid and sandy habitats
195. Hemiptera
196. Gelastocoridae
197. Yes, they're hidden under the head
198. Small insects
199. Tropics
200. Toad

Part 3: Immature Forms

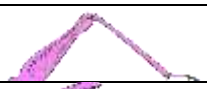
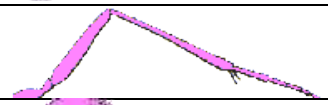
Another part of Entomology is being able to identify immature forms of selected insects. This is really not much different than identifying adult forms.

201. Coenagrionidae
202. Gomphidae
203. Lestidae
204. Aeschnidae
205. Libellulidae
206. Odonata
207. Trichoptera
208. Calliphoridae
209. Culicidae
210. Cerambycidae
211. Tenebrionidae
212. Myrmeleontidae
213. Saturniidae
214. Sphingidae
215. Papilionidae
216. Tenebrionidae

Section 2: Anatomy

Part 1: Legs

1. Coxa
2. Trochanter
3. Femur
4. Tibia
5. Tarsi
6. Pretarsus

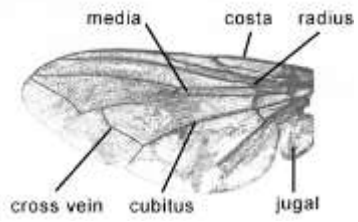
Saltatorial *Grasshoppers*	adapted for jumping	
Raptorial Praying Mantis	Catching & holding prey	
Cursorial Ground beetles; Cockroaches	Adapted for running	
Fossorial Mole Crickets	Adapted for digging in soil	
Natatorial Diving Bugs and Water Beetles	Adapted for swimming	

7. 3 pairs
8. Completed table will look like this: (on the page before this one because of formatting)

Part 2: Wings

You'll have to know about all the different wing adaptations of insects. Also, learn about wing venation. Here's a table with the wing adaptations: (is tiny because of formattina issues, you'll be able to read it when it's printed)

9. .



Elytra *Coleoptera and Dermaptera*	Hard, sclerotized front wings; serve as protective covers for membranous hind wings	
Hemelytra *Hemiptera, Homoptera*	Front wings that are leathery or parchment-like at the base and membranous near the tip	
Tegmina *Orthoptera, Blattodea, and Mantodea*	Front wings that are completely leathery or parchment-like in	
Halteres *Diptera*	Small, club-like hind wings that serve as gyroscopic stabilizers during flight	
Fringed wings *Thysanoptera*	Slender front and hind wings with long fringes of hair	
Hairy wings Trichoptera	Front and hind wings clothed with setae	
Scaly wings *Lepidoptera*	Front and hind wings covered with flattened setae (scales)	
Hamuli *Hymenoptera*	Tiny hooks on hind wing that hold front and hind wings together	
Frenulum *Lepidoptera*	Bristle near base of hind wing that holds front and hind wings together	

10. Two pairs
11. Halteres
12. Gyroscopic stabilization during flight
13. Coleoptera
14. Front wings that are leathery and parchment-like in texture; Orthoptera, Mantodea, Blattodea

Section 3: Taxonomy

This one is really self explanatory…. Just copy the characteristics and ranks onto your notes and you'll be good.

15. Fill in the blanks. Also, under each taxon, list as many required characteristics for each as you know. Kingdom is done for you.

Insects are members of….

- Kingdom Animalia

Multicellular; Heterotrophic; Eukaryotic

- Phylum Arthropoda

Invertebrate; Have exoskeleton; Segmented body; Joined appendages; bilateral symmetry; Lots of pairs of legs

- Subphylum Mandibulata

Modified appendages (mandibles) flanking the mouth and used as jaws

- Superclass Hexapoda

6 legs; Head, thorax, abdomen

- Class Insecta

Invertebrates; exoskeleton made of chitin; 3 pairs of jointed legs; compound Eyes; 1 pair of antennae