

CLASSIFYING, NAMING AND IDENTIFYING ORGANISMS

Time recommended: 2 hours

- The aim of the exercise is to improve understanding and development of the following key topics and skills:
 - ◉ principles and importance of classification and taxonomy
 - ◉ the importance of Linnaeus' contribution to science
 - ◉ using and constructing keys
 - ◉ making valid and reliable observations
- The exercise could be used as a teaching tool to introduce the topic of keys. Some prior knowledge of classification, covered in Worksheet 1, is assumed.
- The exercise requires access to the internet.
- It would be useful to complete Worksheet 1 '**WHAT'S IN A NAME? CLASSIFYING AND NAMING ORGANISMS**', before Worksheet 2.
- For notes on the mark scheme see page 8.

The Linnaean Collection

This exercise makes use of the Linnaean collection, which is kept at the Linnean Society in Piccadilly, London. It is the collection of the Swedish scientist Carl Linnaeus (1707-1778). The Linnaean collection contains around 19,000 specimens and 3,000 letters from Linnaeus' collection, and over 27,000 plants and 6,000 insects from Sir James Edward Smith's collection. The whole Linnaean collection, including plants, fish, shells and insects, has now been made available online. This worksheet will focus on some of the insects.



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Carl Linnaeus (1707-1778)

Warning!

There are lots of Latin and Greek names; the worksheet 'What's in a name?' explains why. Don't be put off by them. Some useful translations are provided in the table below.

word	Latin (L) or Greek (G)	English translation	example
hymen	G	membrane	Hymenoptera
ptera	G 'pter'	wing	Hymenoptera
Apis	L	bee	<i>Apis</i>
mellifera	L 'mellis'	honey	<i>Apis mellifera</i>
	L 'fero'	to produce	<i>Apis mellifera</i>
Arthropoda	G 'arthron'	joint	arthropod/Arthropoda
	G 'podos'	foot	arthropod/Arthropoda

WHO ARE YOU?

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Pollination is a vital service carried out by bees

Many of the insects which you can see in the online Linnaean collection belong to a group known as the Hymenoptera, which includes bees, wasps, ants and some less well known insects. About 100,000 different species of hymenopterans have been described (compared with 54,000 known vertebrates) - undoubtedly many more thousands remain undiscovered. They are of great importance, both ecologically and economically. For example, it is estimated that crops worth about 7 billion pounds a year are dependent on bees for pollination. The honey industry, which is entirely dependent on the honey bee *Apis mellifera*, is worth around £13 million a year.

Q1 Linnaeus introduced binomial nomenclature as a method for naming living organisms. Explain what is meant by 'binomial nomenclature'.

binomial means using 2 names;

genus name and a species name;

nomenclature means naming;

2 max

Q2 From the passage above, what is the binomial for the honey bee?

Apis mellifera written in italics;

1

Q3 The full classification of the honey bee involves the usual seven groups of the taxonomic hierarchy for animals. Three of these are shown below. Complete the blanks with the four remaining groups.

Kingdom: Animalia

(a) Phylum; Arthropoda

1

(b) Class; Insecta

1

(c) Order; Hymenoptera

1

(d) Family; Apidae

1

Genus: *Apis*

Species: *mellifera*

Q4 The honey bee is classified as an **arthropod** and a **hymenopteran**. Using the table on page 1, what do these names and its binomial tell us about the honey bee?

arthropod: jointed feet/jointed limbs;

hymenopteran: membrane(ous) wings/wings are like membranes/wings are thin and transparent;

Apis mellifera: a honey-producing bee;

3

Q5 (a) Define the term 'taxonomy'.

the science of classification / the science of placing organisms into groups and naming them;

1

(b) Explain what is meant by the term 'taxonomic hierarchy'.

organisms are classified into groups/levels;

groups of organisms are combined within larger (composite) groups;

there is no overlap between groups;

higher groups/levels have more organisms/species / are larger / than lower groups/levels;

2 max

WHO ARE YOU?

Linnaeus' Collections

The prime scientific importance of Linnaeus' collections is that they contain many **type specimens** for the species he described. A type specimen is usually the first member of the species to be scientifically described and acts as a reference point to confirm whether or not another organism belongs to the same species. Type specimens are of critical importance in taxonomy.



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Type specimen for *Vanessa atalanta* (named *Papilio atalanta* by Linnaeus)

Q6 Define the term 'species'.

*a group of organisms that can interbreed;
closely related/show close (observable) similarities;
interbreed to produce fertile offspring;
accept any other reasonable suggestion;*

2 max

Q7 Suggest two reasons why a scientist might want to refer to a type specimen in the on-line Linnaean collections.

*To help identify a specimen they have collected;
To check if an organism is a new species;
To help describe the species (in detail);*

2 max

You will need access to the internet for the following.

1. Access the Linnaean Collections Online using the web address:
www.linnean-online.org
2. Select 'Insects' from the top menu.

The Linnean Collections



Home | About | Herbarium | **Insects** | Fish | Shell | Correspondence | Search | Help

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Welcome to The Linnean Collections

The Linnean Society is the custodian of Linnaeus' collections, which comprises specimens of plants (14,000), fish (168), shells (1,564) and insects (3,198) acquired from the widow of Carl Linnaeus in 1784 by James Edward Smith as well as Smith's own plant (17,000 specimens) and insect (5,800) collections. The collections also include the library of Linnaeus (some 1600 volumes) and around 3000 letters and manuscripts.

It is the Linnean Society's aim to make available its primary research material in digital formats to support taxonomic and conservation efforts worldwide as well as providing public pleasure and enjoyment.

Atom RSS 1.0 RSS 2.0

[About this Repository](#)

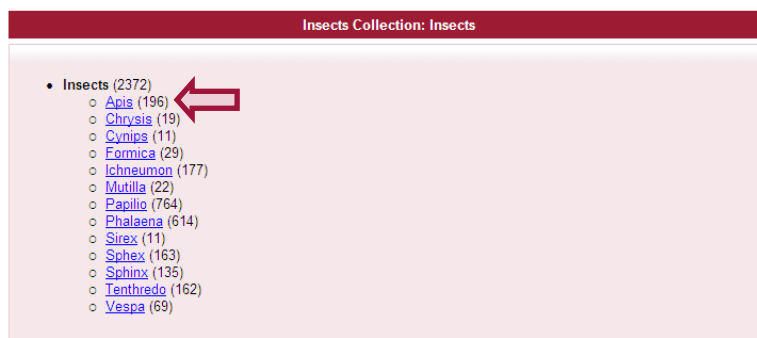
This digital archive of unique material relating to the society's priceless collections of specimens, manuscripts and letters will enable full global access for investigation allowing researchers to rapidly check details of the specimens on-line, including morphological details and written data.

The information is of critical importance to correct naming and identification of specimens. The type specimens represent the original concept of new species, exemplified by the specimens and illustrations used when assigning binomial scientific names, the foundation stones of taxonomy.

The collections are constantly referred to by researchers throughout the world and many specimens have been cited and/or illustrated in taxonomic papers.

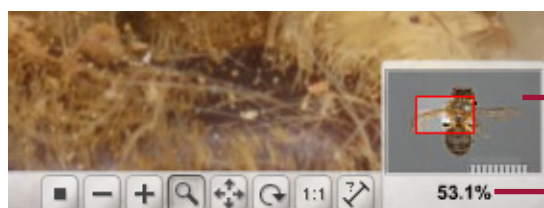
All of Linnaeus' insect collection, consisting of 3,198 specimens, is now available to view online. There are 196 **specimens** of the genus *Apis* and 59 different **species** of *Apis*.

The Linnean Collections



Number of items at this level: 0.

3. Click on [Apis](#). A list of the 59 *Apis* species is shown (plus 78 specimens, listed under '[sp.](#)', whose species is unknown).
4. In order to see 'thumbnail' photos of the specimens click on a link to the species you are interested in viewing.
5. A larger picture of each thumbnail is visible if you drag the mouse cursor over the picture.
6. Click on the thumbnail to access the specimen for closer viewing.
7. Click on '[Zoomable image](#)'. The toolbar in the bottom right corner of the picture allows you to magnify any part of the specimen, measure it, etc. (drag the mouse cursor over the toolbar icons to find out what you can do).
8. If you want to compare two or more specimens click on the images you want so that they are all open at the same time – move those you want to compare alongside each other .



Thumbnail image with
moveable field of view

Zoom level

Toolbar - hover the mouse cursor over a
tool to see its function

Click on *Apis mellifera*, the honey bee.

There are four specimens ('items') of the honey bee, LINN 2818, 2819, 2820 and 4929.

Specimens 2818, 2819 and 2820 each have two photos of the same bee viewed from different angles, plus a photo of the label that belongs with that bee.



Apis mellifera (LINN 2820)

Q8 Suggest what LINN refers to.

Linnaeus/Linnaean;

1

Q9 Which specimen of *Apis mellifera* is the type specimen? (It is recorded on the label as 'Lectotype'; 'lecto' comes from the Greek word 'lectos', meaning 'selected'/'chosen'. Note that the other two specimens are 'paralectotypes' – 'para' is Greek for 'beside'/'near'/'parallel').

No. 2819;

1

Q10 The labels give very little detail about the specimens. This is one of the difficulties with some old collections. Suggest what information it would be useful for biologists to include about collected and preserved specimens.

(name of) location (including country);

coordinates (GPS Geographic Position Systems)/ latitude and longitude;

elevation (from maps or GPS);

date (to avoid confusion with the American system, record day first in Arabic, not Roman, numerals, then month (abbreviated letters, e.g. Jan) and year).

collector's identity;

collection method;

habitat/microhabitat information;

identity of the specimen;

name of the person who identified it;

date identified (subsequent classification may change);

sex of specimen/caste (e.g. queen, worker, drone);

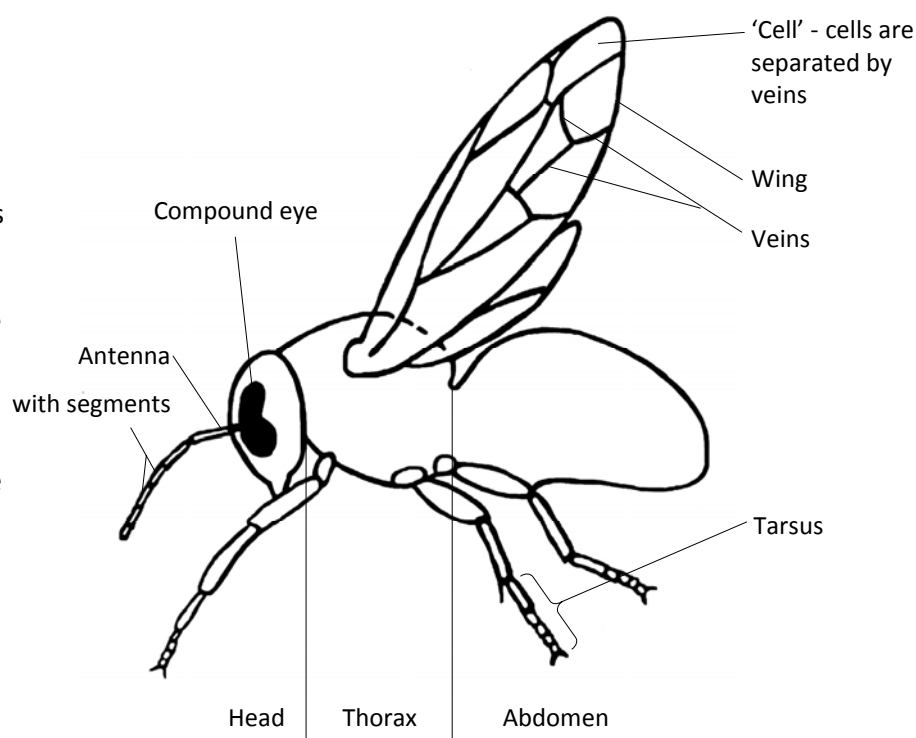
time of capture;

5 max

Using a Key

Given that there are 255 species of bees in Britain (although *Apis mellifera* is the only species of *Apis* in Britain), there is a problem of identifying the species when, for example, biologists are doing fieldwork. This is true for all living organisms, but the small size of insects and their large numbers make identification a particularly difficult challenge. In order to help, keys (either written or picture keys) are commonly used to identify organisms. Keys are often **dichotomous**. This means that you get two choices at each step. This helps to make them simple to use.

Before using a key, it is useful to know a little about the body structure of insects and the hymenopteran group. This diagram gives information about the names of the body parts.



WHO ARE YOU?



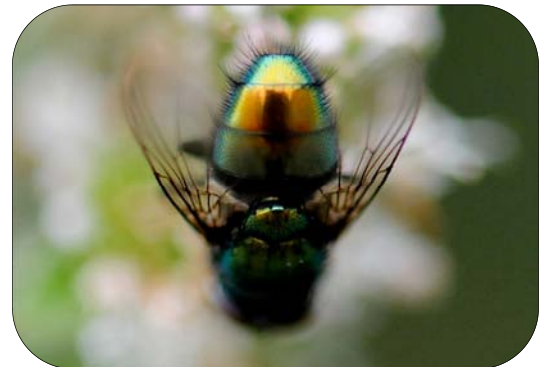
All Hymenoptera have two pairs of wings

All the Hymenoptera have two pairs of wings. However, the front wings are attached to the hind wings, so they function as one pair of wings. Each hind wing has a row of tiny hooks on its front edge which fits into a downward fold along the rear edge of each front wing.

Specimen 2820 in the Linnaean collection is useful because the wings have become separated, showing clearly the two pairs.

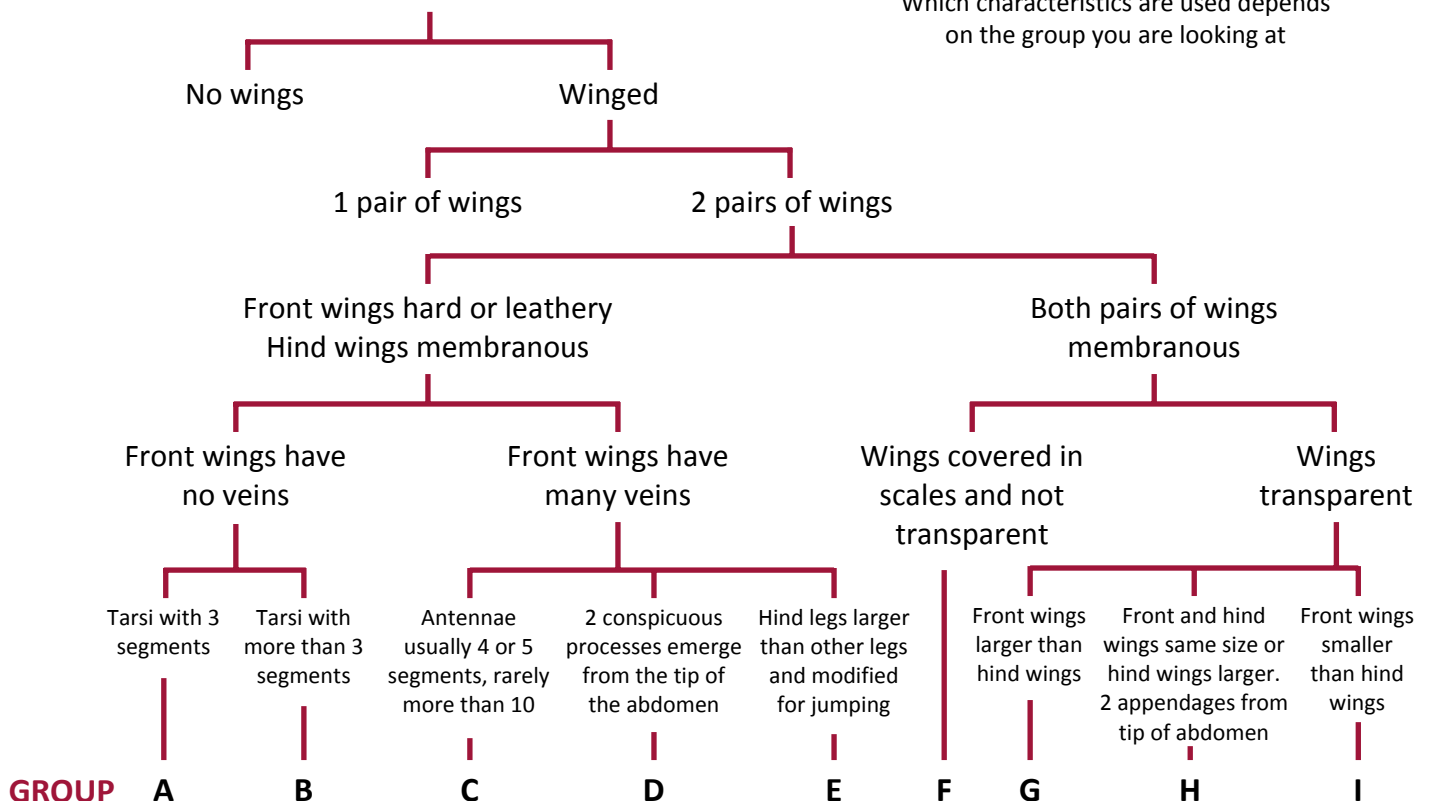
Examine the left hand photo (Zoomable Image) of Specimen 2820 which shows the dorsal (top) side of the bee. From the point where the right hind wing joins the body to just over half way along its front edge you can see a narrow dark strip. Magnify this 100% and you can see a row of tiny hooks projecting from the dark strip. You may just about be able to see individual curved hooks, especially near the body.

Below is a key to some of the groups of insects. You can see that a range of physical characteristics may be used to distinguish between species, including the number and structure of wings, the number of segments in different body parts such as antennae and tarsi, or the presence of special adaptations. Which characteristics are used in a key will depend on the group you are looking at.



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Which characteristics are used depends on the group you are looking at



- Q11** Using the three specimens of *Apis mellifera*, or any of the other species of *Apis* in the collection, as examples of hymenopterans, which one of the letters **A** to **I** represents the Hymenoptera? You are advised to check other species of *Apis* until you find a suitable specimen if you are not sure.

G;;;

H or **I**;;

F;

3

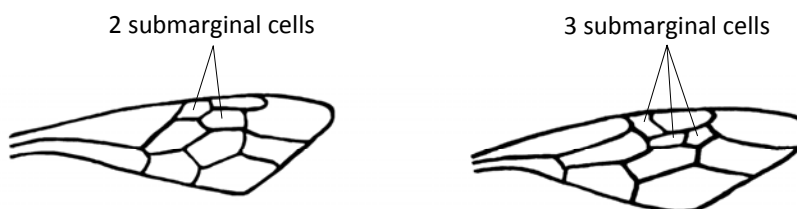
(**A** Dermaptera, **B** Coleoptera, **C** Hemiptera, **D** Dictyoptera, **E**, Orthoptera, **F** Lepidoptera, **H** Ephemeroptera, **I** Plecoptera)

It may be difficult to judge the relative sizes of front and hind wings in *Apis mellifera* specimens. Other *Apis* specimens show the difference more clearly, e.g. *A. caffra*, *A. carbonaria*.

Wing veins are one of the most important characters used for identification of hymenopterans. A key to the genera (genera is the plural of genus) of British bees includes the following choice:



The diagram below shows the location of the submarginal cells.



- Q12** Does *Apis mellifera* have two or three submarginal cells?

3;

1

(the left hand photo of specimen 2820 shows this particularly well at 100% magnification)

- Q13** The genus ***Tenthredo*** belongs to a group of hymenopterans known as sawflies. A key feature distinguishing sawflies from other hymenopterans is their different body shape.

Use the Linnean collection of insects to study the body shape of *Tenthredo* and a range of other hymenopterans. The other hymenopteran genera visible online are ***Vespa***, ***Formica***, ***Chrysis***, ***Ichneumon***, ***Mutilla***, ***Sphex*** and ***Apis***. (These Latin and Greek names are explained in the box on page 8.)

How does the body shape of *Tenthredo* differ from that of other hymenopterans?

Tenthredo has no 'waist'/all other hymenopterans have a (very) narrow waist;
between thorax and abdomen;

2

Accept correct observation even if poorly expressed

Accept reverse argument, e.g. 'Tenthredo body more cylindrical/uniform in width'

WHO ARE YOU?

Q14 For each of the following insects, suggest a characteristic feature which would help to distinguish it from *Apis* in a key: *Vespa*, *Formica*, *Chrysis*.

Vespa: yellow abdomen with black stripes (warning colouration)/wings very narrow/crescent-shaped eyes/wings (folded) along length of body/less hairy/colour due to body not hairs on body;

Formica: no wings/antennae elbow-shaped or bent/'waist' or front part of abdomen is very thin;

Chrysis: brightly coloured (metallic greens, blues, red);

OWTTE in all cases

3

Genus	Latin (L) or Greek (G)	English translation
<i>Tenthredo</i>	G 'tenthredon'	a kind of wasp
<i>Vespa</i>	L	wasp
<i>Formica</i>	L	ant
<i>Chrysis</i>	G 'chrysos'	Gold (see online photos for body colour)
<i>Ichneumon</i>	G	a spider-hunting wasp
<i>Mutilla</i>	L	Cut off (most females have no wings)
<i>Sphex</i>	G	wasp



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Total 33 marks

Notes on mark schemes:

; indicates award of 1 mark

text in brackets is not required for the mark

/ means alternative responses

OWTTE: or words to that effect

words underlined are essential

Educational resources from the Linnean Society of London

For more information contact:

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Email: education@linnean.org



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