The use of stick insects in schools

■ Phil Bragg

Some uses of stick insects in schools are outlined and suitable species are listed. The general nature and variation of stick insects is discussed. Some species are illustrated. Some useful facts, references and sources of further information are given. A copyright-free care sheet and cage construction details are provided.

The Amateur Entomologists' Society recently published the results of a survey into interests of young entomologists [1]. The third most popular group was the Phasmids (stick and leaf insects), with 46% expressing an interest in the order and 21% ranking them first or second in order of interest. When asked where their initial interest in insects began the largest single influence was found to be schools. The link between these two findings should be obvious.

The order Phasmida is one of the smallest orders of insects, containing about 2500 species. It is ironical that such a small order contains the biggest insects, *Pharnacia serratipes* is the world's longest insect and *Heteropteryx diatata* is a contender for the title of heaviest insect [2]. Many have very bright colours or spectacular wings or impressively large spines like *Dares nolimetangere* (Figure 1) or interesting behaviour.

Sadly the order Phasmida has a poor reputation, most people are familiar with *Carausius morosus* the 'indian' or 'laboratory' stick insect, and wrongly assume the whole order is as plain. This is not the case, as anyone who recalls the mention of Macleay's Spectre in *School Science Review* [3] will realize. The value of Phasmids in schools is much under-rated. I shall attempt to improve the situation by outlining some of the possible uses.

Figure 1 *Dares nolimetangere*, male : from Sarawak

There are various reasons why little notice is taken of the order. Only one species is regarded as harmful, *Anisomorpha buprestoides* from the USA; it sprays a fluid which is irritating and can cause temporary blindness if it gets into the eye. Only a small proportion are pests of crops and outbreaks of pest proportions are generally quite rare. The majority of Phasmids inhabit tropical areas, particularly rain forests; there are only three British species [4], so the British entomologist rarely encounters them. In addition to all these problems, the order is largely nocturnal and relies on near perfect mimicry as its main form of defence.

However there are many very good reasons why more study of the order should be encouraged, especially in schools. They are generally large (the smallest is 1.5 cm) and therefore they are very suitable for anyone interested in looking at the structure of insects. It is very convenient to hold up a specimen of a species such as

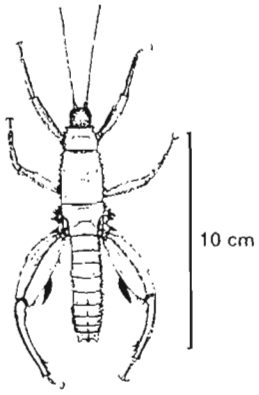

Figure 2 *Eurycantha calcarata*, male : from New Guinea

Eurycantha calcarata and point out the spiracles to the whole class at once! Most are harmless, bites are almost unknown and those are as a result of provocation. Only a few are equipped with spines which are large enough to be damaging. *Eurycantha clacarata*, especially the male (Figure 2) can cause injury with the large spines on the back legs if they are carelessly handled; but they are easy to tame and once picked up even an untamed individual soon calms down. Quite a few species are easy to breed in captivity, a selection of the easiest are listed in Figure 3. There are currently about 80 species being reared in captivity, this is 3% of the described species!

As a general rule animals in school present problems with feeding; this is not the case with Phasmids. It is possible for Sir or Miss to go for a whole year without feeding them, the main problem being to break up the fights between the pupils who are

Scientific name	Geographical origin	Notes 1	2	3	Foodplants
Carausius morosus (Sinéty)	India	P	S	–	P I H B Ro
Bacillus rossius (Rossi)	Europe	P	S	–	B Ro
Sipyloidea sipylus (Westwood)	Madagascar	P	S	W	B Rh Ro H
Baculum extradentatum (Brunner)	Vietnam	S	S	–	B Ro
Extatosoma tiaratum (Macleay)	Australia	S	M	W	B O E
Acrophylla wuelfingi (Redtenbacher)	Australia	S	L	W	B O E Ro
Heteropteryx dilatata (Parkinson)	West Malaysia	S	M	W	B O
Baculum thaii Hausleithner	Thailand	S	M	–	B E O Ro
Eurycantha calcarata Lucas	Papua New Guinea	S	M	–	B H I O
Libethra regularis Brunner	Trinidad	S	S	–	B I O Ra Ro
Diapheromera femorata (Say)	USA & Canada	S	S	–	O B
Paramyronides perakensis Redtenbacher	West Malaysia	S	S	–	B Ro
Calynda brocki Hausleithner	Costa Rica	S	M	–	B Ro
Phenacephorus cornucervi Brunner	Sabah	S	S	–	B Ra Ro
Rhaphiderus scabrosus (Percheron)	La Reunion	S	S	–	Rh E B O Ro
Paraphasma rufipes (Redtenbacher)	Peru	P	S	W	P
Dyme rarospinosa Brunner	Peru	S	M	–	B O
Parahyrtacus gorkomi Hausleithner	Philippines	S	S	–	B E
Baculum insignis (Wood-Mason)	India	S	L	–	Ro B
Lonchodes amaurops Westwood	Sarawak	S	M	–	B H P Ra Ro

NOTES

1 Breeding: S = sexual; P = parthenogenetic
2 Length of species: S = < 10 cm; M = 10 – 15 cm; L = > 15 cm
3 Wings: W = wings present in one or both sexes

FOODPLANTS

Alphabetically listed unless a definite preference is known.
B = bramble; E = eucalyptus; H = hawthorn; I = ivy; P = privet; Ra = raspberry; Rh = rhododendron; Ro = rose

Figure 3 Species of Phasmids which are relatively easy to maintain in schools

keen to do the job! They will happily last the half-term break without attention; with a little thought and ensuring the cages are not too crowded, they will not need attention at Christmas or Easter. The summer holidays have never presented me with a problem, there are always eager pupils with parents willing to let Sally or Jimmy act as the zookeepers. The problem of obtaining food is usually a minor one, once you realize that most species will eat a variety of food. The typical foodplant used for *Carausius morosus*, privet, is unusual, most species will not touch it. If you insist on using only privet there are only two other species in culture which are known to eat it, *Paraphasm rufipes*, a red winged species from Peru and *Lonchodes amaurops*, a polymorphic species from Sarawak. The latter species was collected by myself two years ago and has only recently become generally available. Although not well known at present, it is a very easy species to keep and should become very widespread. Most species thrive on Bramble, many take Rose, Hawthorn and Oak; both Bramble and some species of Oak are available all year round. However it may be wise to use other food in summer to avoid over collecting your winter supplies! Recently I had a letter from Finland, asking for species which will feed on Rhododendron as Bramble is too difficult to obtain in the Finnish winter, fortunately I was able to oblige with several species.

One matter which must be considered by the biology teacher is that of availability; it is no use planning to use stick insects for a fifth year assessed practical only to find that all the adults have died and only newly hatched nymphs remain. As a general rule it is advisable to maintain a continuous culture of insects at all stages. To do this it is necessary to keep more eggs than you expect to need and then cull the stock to prevent over crowding. The culling can be done directly by putting the unwanted insects into a jar containing fumes of ethyl ethanoate (ethyl acetate) or by putting them into the freezer. An alternative is to use them as food for other animals. Stick insects are suitable food for lizards, frogs, newts, axoltles, spiders and scorpions; in fact almost any carnivorous animal will eat them. I always feed stick insects which die from natural causes to the cockroaches. Dead insects are much preferred to a diet of fruit and are closer to the natural diet of cockroaches. If you do not wish to keep a continual supply of live adults you may wish to preserve a few specimens. This is quite easy to do, the best results are obtained by either drying in an oven at 80 °C, or injecting them with alcohol or by evisceration and stuffing with cotton wool; details of these methods have been given elsewhere [5].

Very little is known about the majority of the Phasmids, for many species there are no records other than the original specimen. The eggs, food plants and behaviour are totally unknown for almost all species. Even simple things such as alternative food plants and egg laying rates have rarely been investigated even for captive reared species. This means there is plenty of scope for pupils to do real investigative work where the answers are not known; a true contribution to science is possible by the pupils.

Formed in 1980, The Phasmid Study Group, as its name suggests is devoted to the study of this impressive order. The group has members in over twenty countries throughout the world, although the majority are in Britain. It produces a quarterly newsletter which averages over twenty pages and surplus livestock is distributed free to members. The Newsletter is unusual in that it publishes a complete range of articles, from one line observations to detailed articles of many pages; the information may be a description of a new species or a two line report of a new food plant for *Carausius morosus*. The editors aim to publish any items relating to Phasmids and submissions are rarely declined. Membership is open to both individuals and organizations such as schools. The Newsletter offers an excellent opportunity for pupils to see their own results published.

One problem faced by the teacher is the scarcity of information on Phasmids. Apart from the Phasmid Study Group Newsletters and the few specialist books available (listed on the care sheet), there is little literature that can readily be found. Here are a few obscure facts with which you can amaze and astound your pupils! Some species such as *Haaniella grayi* from Sarawak are eaten by the local Dayak tribes [6]. The spiny back legs of *Eurycantha latro* have been used as fish-hooks [7]. The so-called 'British species' are an excellent example of accidental introduction by man [8], all the way from New Zealand! Members of the genera *Haaniella* and *Heteropteryx* produce a loud rustling sound to scare off predators by rubbing their wings together. A cartoon about stick insects was produced as long ago as 1851 [9]. The Chinese use stick insect droppings to make a herbal tea which is used to treat diarrhoea, and according to the medical profession, it works! Fighting in Phasmids is rare but the males of some species such as *Eurycantha calcarata* will fight for possession of a female; they will also kill any deformed members or their own species. Most species reproduce sexually yet many are also able to reproduce by parthenogenesis. Occasionally gynandromorphs occur, some of these are very spectacular such as those of *Heteropteryx dilatata* which can have one side with male colouration and one with female colouration [10]. There is strong evidence [11] that all male Phasmids produce their sperm in a bag known as a spermatophores in order to transfer the sperm to the female. When a Phasmid loses a leg as a young nymph it will regenerate the leg as it gets older. If an antenna is lost it is usually regenerated but occasionally it may regrow as a leg! The South American genus *Prisopus* and *Cotylosom dipneusticum* from Fiji were once thought to be aquatic, the leafy projections on the abdomen were mistaken for gills.

The order is sexually dimorphic, ie, the males and females often look totally different; as you would expect the female needs

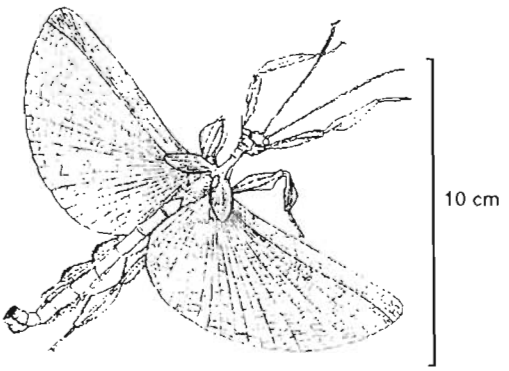

Figure 4 *Extatosoma tiaratum*, male : from Australia

to be larger to produce all the eggs. In some species such as *Extatosoma tiaratum* the female is so large that she cannot fly and has vestigial wings while the male (Figure 4) has strong wings and is an excellent flier. For many species only one sex is known, or in some cases such as *Lonchodes amaurops* (Figures 5 and 6) the male has been described with one name the female with another. In the case of at least one species, *Phenacephorus cornucervi*, the females are so polymorphic that they have been described as different species! This can raise all sorts of taxonomic questions such as how a species is defined and what constitutes a subspecies.

There are many undescribed species yet to be found, in 1989 I found a new species while doing a survey in a National Park! There are no restrictions on importing

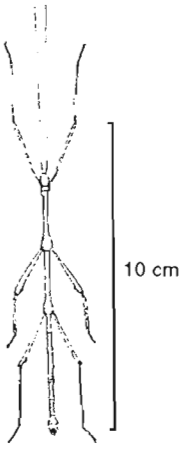

Figure 5 *Lonchodes amaurops*, male: from Sarawak

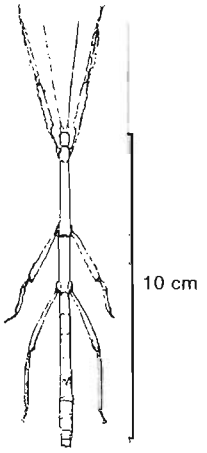

Figure 6 *Lonchodes amaurops*, female : from Sarawak

Phasmids into the UK. Very few countries have restrictions on exporting Phasmids, those that do are ones where there is a restriction on all insects. This means that pupils can follow up an interest while on holiday abroad and bring livestock back to school. I was recently given a *Ramulus sp* which a pupil's grandparents had collected for me while they were on holiday in Africa!

Their biggest potential contribution to education is the removal of the 'I hate creepy-crawlies' syndrome. While not guaranteed, a spectacular body colour like the almost fluorescent green of *Heteropteryx dilatata* and *Rhaphiderus scabrosus*, or the spectacular red wings of *Paraphasma rufipes* can be very effective in overcoming the first hurdle. If this does not work, a progressive introduction starting with a delicate newly hatched nymph can have the desired result. This applies to both the pupils and the more difficult chemistry and physics specialists in the science department!

The National Curriculum offers plenty of scope, indeed, almost a requirement, for the use of Phasmids in school. You cannot ignore insects when covering Attainment Target 2, 'The variety of life' part of the National Curriculum; they account for 75% of all animal species. What better way is there to show insects than to use a few large stick insects? Phasmids can also be useful in AT3, 'Processes of life', and AT4, 'Genetics and evolution'. Recently Parwani [12] outlined the use of Phasmids with a class of junior school pupils, using them to cover attainment targets in science, maths, language and technology.

One of my science pupils has recently had an essay published; he was a runner up in the WH Smith young writers competition with a story about a stick insect [13]. I hasten to add that this was nothing to do with me, he wrote it in an English lesson!

A few months ago I received a request for stick insects to star as 'alien invaders' in a video being made by a pupil in Devon as part of one of his GCSE courses. Obviously his school doesn't keep stick insects. Why not?

I have been keeping Phasmids for over twenty years, ever since I was introduced to them at the age of eleven by Henry Berman, my biology teacher at St Ivo School, Cambridgeshire. I have been using Phasmids in my own lessons for the last ten years, from 1st year to 6th form. At Becket School our pupils are given live stick insects and crickets to compare a a GCSE assessed practical. While I usually limit spending a whole science lesson on Phasmids to 1st year science lessons or A-level practical investigations, they can often be used to either introduce a topic or to illustrate a point in other lessons. You don't need to be an expert on stick insects to make good use of them; all you need to do is to teach your usual lesson but bring in a stick insect as a visual aid where appropriate. You can also base investigations on them, often easier than using the traditional woodlice and maggots which have a higher repulsion factor for most pupils. Some suggestions for various experiments are made by Brock [14], Floyd [15] and Clark [16] while unit nine in the ABAL series [17] gives details of an interesting practical to investigate food consumption and productivity in Phasmids. In addition, why not consider using them in a few of the following contexts:

Defence, passive and active
Evolution: why losing legs can be advantageous
Selection of egg laying sites
Relationships between insect size and the number and size of eggs
Advantages and disadvantages of asexual and sexual reproduction
Sexual dimorphism
Polymorphism
Diversity of living things
Identification keys: use of keys, making keys
Food plant preference
Habitat preference
Morphology of insects
Insect life cycles
Camouflage
Growth rates
Man's effect on animal distribution (eg British species)
Food sources, protein for humans and other predators!
Examples of pests
Care of animals in captivity
Microscope use, looking at eggs, antennae, mouth parts
Breathing, production of CO_2
Effects of temperature on metabolism
Captive breeding for conservation
Technology: cage design and construction
Statistics: length, mass, eggs; mean, median, mode, chi-squared
Geography: where is Peru?, Sabah?, Sarawak?, Costa Rica?, etc...
Art: drawing insects, food plants, eggs

Reproduced under the heading *Stick Insect Care* is a caresheet and cage construction sheet which I issue to interested pupils. The cage design (Figure 7) is for a standard cage which I have used over many years and is suitable for all species. Suitably laid out with narrow margins and reduced in size, the caresheet and cage construction details will fit nicely on to two sides of A4 paper. It is copyright free, so why not use it?

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STICK INSECT CARE

Stick and leaf insects belong to the order PHASMIDA. There are about 2500 species known in the world. There is a lot of variety in both the insects and their habitats. Depending on the species, stick insects can live from one to five years. Sizes range from a few centimetres to half a metre long. Phasmids include the longest insect in the world and one of the heaviest. The following information applies to most of the species which are commonly available in Britain.

HOUSING

The height of the cage must be at least twice the length of the insect, to allow it to shed its skin. It is advisable to try to have the height at least three times the length of the adult insect. Cages can be made from almost anything. Fish tanks stood on end with cloth or netting covering the front are quite good. Tall sweet jars with small holes in the top are very good for young insects or a few adults. Even cardboard boxes with air holes and plastic or netting tops can be used, although they are far from ideal. As with any animal, a purpose built cage is best, the most suitable are based on a wooden frame covered in fine netting, with a glass or perspex front. It is necessary to put plastic sheeting outside the netting to maintain humidity for some species.

HEATING

Stick insects are almost all tropical and should be kept at room temperature or slightly above (15-25 °C). The cage can be heated with a light bulb if required. Beware of keeping them on window sills where the cage may overheat on sunny days.

FOOD

Almost all species kept in the UK eat bramble leaves, many also eat rose, raspberry, oak, hawthorn, eucalyptus and some eat rhododendron, ivy or privet. The food plant should be kept with the bottom ends in a jar or bottle full of water. The short (15 cm) style of milk bottle are useful for this. Make sure there are no leaves in the water as they will quickly rot and start to smell. The top of the bottle should be plugged with tissue or newspaper to prevent drowning. Kept like this the food can last two weeks but remember that they cannot eat dead leaves.

Finding food in winter can sometimes be a problem as a very hard frost can kill the bramble leaves. However it is possible to find suitable bramble in sheltered places such as in woods, thick hedgerows, overgrown gardens etc. Stick insects are edge feeders, that is they nibble the edges of the leaves not the surface. If the leaves are frost damaged around the edges you should trim off the dry pieces with a pair of scissors. Beware of feeding very new leaves in spring, they seem to be poisonous as many species refuse to eat them; try to offer a choice until you are sure the new leaves are being eaten.

WATER

Stick insects do not need a constant supply of drinking water. However many species need humid conditions to do well and should be lightly sprayed with water each evening. They will often drink the drops of water on the plants.

CAGE MATES

Stick insects should not be kept with other insects as they may be mistaken for twigs and eaten. Different species can be kept together but beware of keeping bulky species with fragile species.

BEHAVIOUR

Most stick insects are nocturnal, feeding and moving around in the evening and at night. The warmer they are the more active they will be; but this means they will eat more, grow faster and die faster. As a general rule the flying species will only fly when the weather is warm. If stick insects are overcrowded or under fed they may bite each other, causing loss of limbs. Limb loss can also occur if the insect is disturbed while shedding its skin. The limbs will regrow if they are lost when young but adults and large nymphs cannot regrow lost limbs. Lifespan can be between nine

months and five years, it varies with the species and the temperature; most species live about one year. Several species produce a smell as a means of defence, in the case of *Anisomospha buprestiodes* this is painful if it gets into cuts and dangerous if it gets into the eyes.

HANDLING

If disturbed during the day many species will play dead to begin with, in the hope that you will go away! However they usually give up quite soon and can be quite active. Care is needed or the insect may shed legs; avoid gripping the legs or pulling them off their perches. Care is also needed with the large spiny species which can inflict a nasty cut, however they usually tame easily and are not a problem once they have been picked up.

BREEDING

Some species are parthenogenetic; males do not occur, the female produces fertile eggs without being mated. Most species do have both sexes although often the female is capable of breeding on her own. Eggs which are produced without mating can only develop into females. Very rarely what appears to be a male is produced from a parthenogenetic egg; these 'males' cannot breed. The males of most stick insects are much thinner than the females.

The females start to lay eggs soon after becoming adult. They lay between 2 per week and 15 per night depending on the species. Most drop the eggs on the cage floor. Some bury their eggs in damp sand or peat and a few hide them in cracks or glue them to the food plants and sides of the cage. If you don't get any eggs from adults, you're doing something wrong. Most eggs are easily recognized but some look similar to the droppings. Eggs take from 2 to 15 months to hatch, 3-7 months for most species. The best method of hatching the eggs is to separate them from the droppings and keep them moist; either on damp tissue or damp sand. Most species will hatch at room temperatures but the process can be speeded up by keeping them in a warm place such as an airing cupboard but be careful not to get them above 30 °C. The eggs of the European and North American species may need a cool period to induce hatching; a few weeks in the fridge will help.

BOOKS

The following is a list of the few books specifically on Phasmids. There are sections on stick insects in a few general pet books, but these tend to give less information than that given above.

The Phasmid Rearer's Handbook by Paul Brock. 41 pages, 26 figures. It gives advice on 45 different species, breeding, rearing, housing etc. It is without doubt the best available and an excellent buy at £2.85 (inc post & packing). Available only from: AES Publications, The Hawthorns, Frating Road, Great Bromley, Colchester, Essex CO7 7JN.

Keeping Stick Insects by Dorothy Floyd. It contains some nice photographs but only deals with 7 species. £4.95.

How To Keep Stick Insects by Michael Byron. 20 pages, 19 figures. Only 4 pages on keeping stick insects, the rest is highly detailed description of 8 species which are of little use. £3.50.

Stick and Leaf Insects by JT Clark. Out of print but available from some public libraries (eg Nottingham Central Library).

The Phasmid Study Group Newsletters. Published four times per year, these contain many useful ideas and information. They are issued free to members (see below).

THE PHASMID STUDY GROUP

This is an international group of people who are interested in keeping stick insects. Membership is open to anyone (£3.50 per year) and there is free exchange of member's surplus insects. Details from either myself: Phil Bragg, 8 Cornwall Avenue, Beeston Rylands, Nottingham NG9 1NL or The Membership Secretary, Paul Brock, Papillon, 40 Thorndyke Road, Slough, Berkshire SL2 1SR.

STICK INSECT CAGE CONSTRUCTION

Stick insect cages constructed according to the following guidelines have several advantages over cages which are not purpose built. They are cheap, easy to build, and easy to clean. The ventilation can be adjusted and they can be stacked on top of each other.

The cage consists of a chipboard base and top (melamine coated for easy cleaning), four corner posts, a glass front. Cloth sides and an outer layer of polythene sheeting allow you to control the humidity. The outer layer of polythene can be fixed in place with drawing pins; this allows you to adjust the ventilation and control the humidity. If lights are required to heat the cage, they may be fixed to the top of the cage or to a cross bar between the uprights at the back.

The glass front lifts out to give good access to the cage; this is better than a hinged door as doors tend to trap insects' legs very easily. The glass retaining strip is shorter than the front of the cage so that the eggs and droppings are easily swept out. Perspex can be used for the front in place of the glass. Although safer, it has a few disadvantages, it scratches easily and unless you use very thick perspex, it may flex too much and need stiffening strips attached to the outside to give a good fit. If glass is used, buy 6 mm thick glass it is safer than 4 mm and less likely to break.

Painting the bare wood makes cleaning easier and makes the cage look better. It is best done before building the cage. You may need to touch-up the paintwork when you have finished. The best way to paint the cage is to use two coats of white undercoat followed by one or two coats of white gloss. The cage can be nailed together, but for a smarter looking cage you should use screws and screw caps. If you use screw caps, be sure to use the type which fit into a recess so that you can stack cages on top of each other. The cut edges of the chipboard can be made to look much neater by using some of the iron-on edging strips which are available from most large DIY stores.

The sides are made from material as it provides a good surface on which the insects can climb. Almost any material may be used, however cotton will rot after a few years in a humid atmosphere. Plain, light coloured material makes it easier to see the insects. Unpatterned net curtain material is very suitable as it is both cheap and rot-proof. The material for the sides can be glued in place. Use a glue such as Evo-stick Woodwork Adhesive for absorbent material or Evo-stick Time Bond for non-absorbent material. Alternatively the material may be stapled to the frame.

The cage can obviously be built to any size but the size described below is suitable for most small- and medium-sized species. A double width cage with two sheets of glass and a central upright is a useful option. It will provide a larger cage for small and medium species. An increase in all dimensions will be needed for large species of stick insects.

REQUIREMENTS

1 piece of Melamine coated chipboard 300 × 300 mm
1 piece of Melamine coated chipboard 300 × 285 mm
4 pieces of wood 600 mm long, 20 × 20 mm (or similar thickness)
1 piece of wood approx 300 × 10 × 10 mm
1 piece of wood approx 200 × 10 × 10 mm
1 piece of hardboard or plastic 30 × 15 mm (for the catch)
16 40 mm nails, two for each end of each upright (or 8 40 mm screws)
8 10 mm panel pins
1 25 mm round head screw and a few washers to fit
1 piece of glass 300 × 600 × 6 mm
Cloth and polythene to cover the sides

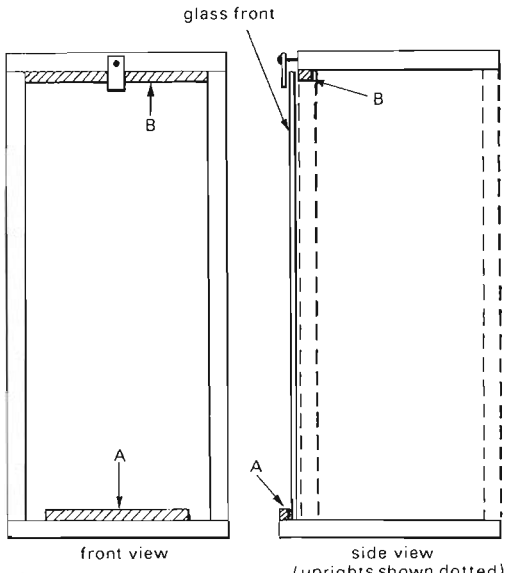

Figure 7 Stick insect cage design

METHOD

1 Nail or screw the corner posts to the top.
2 Nail or screw on the base. Make sure that the base projects forward by 15 mm as the glass has to rest on it.
3 Using three or four panel pins fix the 200 mm long strip of wood (A) into position. Make sure that the glass can easily be lifted out. The top corners of this piece should be rounded off before fixing in place.
4 Cut the 300 mm long strip of wood (B) so that it fits between the front uprights; fix in place using panel pins.
5 Use a piece of sandpaper to smooth off the edges and corners of the glass.
6 Hold the glass in place and see how well it fits. Unless you are an expert at woodwork, you will need to twist the frame a little to make sure it fits flat against the glass.
7 The catch which holds the top of the glass is made from a piece of hardboard or stiff plastic. It is screwed into the top of the cage with a few washers between the catch and the top to allow for the thickness of the glass. If the glass is too loose, take a washer out and tighten the screw. It is a good idea to also put a washer between the screw head and the catch.
8 Touch up any paintwork if necessary.
9 Fix the cloth to the sides and back using either glue or staples.
10 Fix the polythene sheeting over the cloth. The amount used will determine the ventilation, this can be altered if drawing pins are used.
11 It is a good idea to leave a painted cage for a week before using it. This allows time for the fumes to disperse.

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