




National Rivers Authority
Wessex Region



POND PACK



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MAKING A POND

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WHERE?

Aim to have your pond ready for planting and stocking by mid-May.

- (i) Choose a level site.
- (ii) Choose an open site - pond plants need plenty of sunlight.
- (iii) Avoid overhanging trees - their leaves will quickly fill the pond.
- (iv) Avoid wet hollows if you intend to use a flexible synthetic liner! - the liner may float up after the pond has been built.
- (v) Site the pond away from sources of pollution such as roads, the drive or even the compost heap.

HOW BIG?

- (i) The bigger you can make your pond, the better. A very small pond is more likely to overheat in the summer and freeze in the winter. Achieving a balanced ecology therefore is difficult.
- (ii) The area of your pond will obviously depend on the space available but you should aim for at least 4.5 - 5 m².
- (iii) Depth is also important, and the pond should be at least 50 cm deep, and ideally be 60-90 cm deep in places. However, don't dig the pond to this depth all over, leave a shallow shelf, 25-40 cm deep around parts of the edge to support marginal plants.

WHAT SHAPE?

- (i) An irregular shape with curved edges looks more natural and increases the edge length which is available as a key habitat for many forms of wildlife.
- (ii) Don't make the edges too steep. Ideally the slope should be less than 60 cm, but in places should be very much less, say 25-30 cm to allow amphibians to get into and out of the pond. In large ponds a shallow bank profile should be retained around most of the perimeter.

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MAKING A POND

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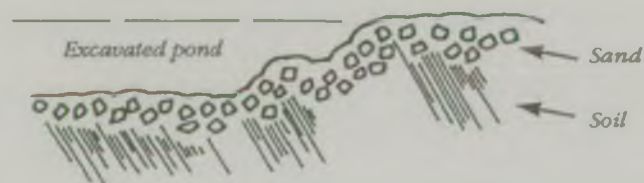
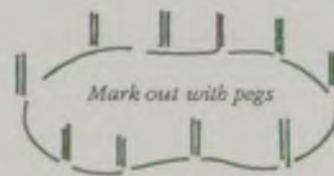
WHAT LINING MATERIAL?

- (i) Concrete can be made to fit almost any shape and is extremely durable as long as the original construction is sound. However, making a concrete pond is fairly technical. Those interested should refer to one of the many books on ponds which are available through most book sellers.
- (ii) Preformed glassfibre or plastic ponds are generally too small (or very expensive) and the choice of shape is limited. However, they are easy to install and are very robust.
- (iii) Flexible liners come in a variety of grades and materials and are very popular. Calculating the size of liner required is very easy. Add twice the depth (D) to the length (L) of the pond and multiply by twice the depth (D), plus the width (W), so the size of liner is (m²) = (2d + L) x (2d + W)
 - (a) Polythene is very cheap but becomes brittle when exposed to sunlight and may only last for a couple of years. Use the thickest gauge (0.375 mm) and cover with soil for best results.
 - (b) PVC is more expensive than polythene, but is more resistant to ageing. By using 0.25 mm thickness, the pond should last for 10 years or more.
 - (c) Butyl rubber is expensive but well worth the extra cost as the pond should last a lifetime. Use 0.56 or 0.75 mm thickness

MAKING YOUR POND

(Assuming that a flexible liner is to be used)

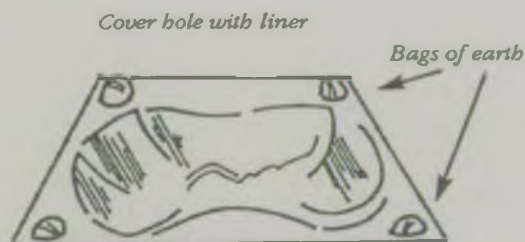
- (i) Level the site - this can be done by using a piece of straight timber and a spirit-level.
- (ii) Mark out your pond with string and pegs or a rope until you are happy with the shape.
- (iii) Dig out the pond to the desired size, shape and profile, remembering to allow room for a layer of sand or sifted soil (see (vi)).



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- (iv) Spend a little time checking that the edge is level - it's much easier now than later.
- (v) Remove any stones or other sharp objects which might damage the liner from the hole.
- (vi) Line the hole, side-walls and the bottom, with a layer of sand, sifted soil, newspapers, old carpet or anything else which will protect the liner.
- (vii) Spread the liner over the hole and weight the edges with bricks or bags of earth.
- (viii) Start running water onto the liner from a hose-pipe. As the weight of water stretches the liner into the hole, carefully adjust the weights around the edge so that the liner is moulded to the shape of the pond. Pay special attention to ensure that any weighting bricks are not dragged into the hole with the liner.
- (ix) When the pond is full, trim off any excess liner, taking into account how you intend to deal with the edges.



MAKING A MARSH HABITAT

Although marginal plants will grow on the shallow shelves around the edge of your pond, many of them, along with other species which will not grow in permanently flooded habitats, will be more successful in a marsh habitat. Such habitats attract a wide variety of invertebrates and vertebrates, especially amphibians.

The object is not to prevent drainage but to inhibit drainage so that the soil conditions are permanently damp and occasionally water-logged. Because there will be some drainage it is important not to link this habitat with your pond although it can closely adjoin the pond so that they appear as one continuous profile.

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The methods used when making a marsh habitat are essentially those already described with one or two differences:

- (i) Excavate a shallow trench of whatever shape you want, making it about 30-50 cm deep.
- (ii) Line the trench with polythelst sheeting - an old pond liner will do, even if it has become brittle in parts.
- (iii) If it has none, pierce a few holes in the bottom to allow some drainage.
- (iv) Refill the trench with the soil. You can add a little compost or well rotted manure provided that it will not get back into the pond.

Marsh habitats can be planted with a variety of species, including those listed as emergent species (See Planting and Stocking Ponds). In addition the following species (among others) can be included:



Newly filled ponds should be left for a week or so before planting. This allows any residual chlorine to escape from the water (if tap water is used). Concrete ponds need to be left longer, and the water replaced several times to remove the lime which leaches out of the concrete.

PLANTING AND STOCKING YOUR POND

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PLANTING - WHEN?

Plants should be introduced into the pond when they are actively growing. This depends on the weather conditions, and can be anytime between April and July.

WHAT SPECIES?

You should introduce a variety of native plants and include examples of submerged, floating or floating-leaved and marginal, emergent species. Some examples include:

<i>Submerged</i> -	Hornwort	<i>Ceratophyllum demersum</i>
	Water-milfoil	<i>Myriophyllum spicatum</i>
	Pondweeds	<i>Potamogeton</i> spp.
	Waterspout	<i>Hottonia palustris</i>
<i>Floating - and floating leaved</i>	Water-lily	White- <i>Nymphaea alba</i>
		Yellow- <i>Nyphar lutea</i>
		Fringed- <i>Nymphoides peltata</i>
	Amphibious Bistort	<i>polygonum amphibium</i>
	Frog-bit	<i>Hydrocharis morsus-ranae</i>
Duckweed	<i>Lemna</i> spp.	
<i>Marginal</i> -	Yellow flag	<i>Iris pseudacorus</i>
	Water plantain	<i>Alisma plantago-aquatica</i>
	Arrowhead	<i>Sagittaria sagittifolia</i>
	Water forget-me-not	<i>Myosotis scorpioides</i>
	Brooklime	<i>Veronica beccabunga</i>
	Water Mint	<i>Mentha aquatica</i>

WHERE FROM ?

It is illegal for anyone, except on their own land or with the permission of the land owner, to uproot any wild plant. However, a polite enquiry to a friend, a farmer or other land owner can often pay dividends. The spoil from a pond which is being cleaned out can provide a lot of plants and animals for stocking new ponds. Alternatively many of the plants listed above can be obtained through your local aquarist or nursery.

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PLANTING AND STOCKING YOUR POND

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HOW DO I PLANT THEM?

Unrooted species such as hornwort, frog-bit and duckweed should be introduced loose to the pond.

Rooted species require planting in soil. Perhaps the easiest way of doing this is to tie the roots into a piece of sacking containing soil and some stones for ballast. Any soil will do, a rich loam being ideal. On no account use compost or manure as this will foul the water. By piercing the sacking in a few places you will enable the roots to spread without splitting the package. Alternatively you can use planting baskets, again adding stones for ballast.

Marginal, emergent species should be introduced onto the shallow shelf around the edge of the pond where they will only be a few centimetres underwater. Floating leaved species such as lilies should be introduced into the deeper water of the pond. Submerged species such as water-milfoil can be introduced into either the marginal shelf areas or the deeper parts of the pond.

WHEN?

Don't put any animals into your pond for about a month after planting. This will enable the plants to get established during which time you may be surprised by the number of animals that appear in the pond. Some of these will have been introduced inadvertently as eggs or juveniles with the plants. Others, such as water beetles, bugs and dragonflies may have flown to the pond as adults. Your aquarist can supply a variety of animals such as snails and Daphnia, while a dip into a friends pond could provide a wealth of other animals. When you are asking for plants, why not ask if you can return later for animals? If you want amphibians (frogs, toads and newts) to use your pond, don't stock it with fish which would eat their spawn and tadpoles.



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Why not have two ponds, one for fish and one for amphibians and other wildlife? If there are ponds close-by which support a lot of amphibians, given time they will find your pond and colonise it.

Alternatively, you might introduce a small amount of frog or toad spawn directly (never take more than a small amount from another site and always get permission from the owner) and the adults should return to your pond in 2-3 years. Smooth and palmate newts can be introduced as adults but great-crested newts are specially protected by law and so must never be disturbed.

FISH

If you do want to stock with fish, buy healthy ones from a reputable dealer - the fish which is lethargic and easy to catch is probably unhealthy and will not survive for long. Remember that in time the fish will grow and might breed; the plants will also grow and multiply and silt will accumulate. These factors effectively reduce the size of the pond so it is very easy to overstock leading to all manner of management problems. To allow for healthy growth and a reasonable balance do not stock more than 2 fish (of any size i.e. 6 small fish do not equal 3 large ones) per square metre of surface area (regardless of depth).

A number of management problems commonly cause concern to the owner of a small pond. These include algal blooms and excessive plant growth, silt accumulation, ice cover and fish disease. For fish husbandry and disease control it is recommended that you consult your local aquarist. There are also a number of very useful books available on the subject.

ALGAL BLOOMS

Algae are microscopic plants that live in water, and when they occur in very large numbers (an algal bloom) the water becomes green and turbid. Blooms are very common during the first year of a new or recently cleaned-out pond the resulting changes in the colour of the water can be alarming but merely show that the natural ecological balance of the pond has not yet established. Do not clean out the pond or refill it with fresh water! This just puts you back to square one. Given time, a balanced ecology will be established with the algae - an important part of the pond community - and the microscopic animals - the primary consumers (ie *Daphnia*) - which feed on them. The water will then clear.

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This delicate balance is, however, easily upset. For instance, fish eat the primary consumers which normally keep the algae in check. Fish ponds, especially those which are overstocked, therefore tend to suffer from persistent algal blooms. Unfortunately there is little that can be done about this condition but you might take some comfort from knowing that most hardy goldfish are quite tolerant of green water! However, submerged aquatic plants will be inhibited by lack of light and other animals are not so tolerant.

Chemical algicides can relieve these symptoms temporarily but they do not solve the underlying cause. Some can even harm other plants and animals, so take care.

So, one cause of algal blooms is (over)stocking with fish. Another is nutrient enrichment which can enable the algae to grow and multiply too rapidly for the primary consumers to keep pace. So don't allow the fertilizers, or for that matter herbicides and pesticides, which you put on your lawn to get into the pond. Similarly, don't spray the pond with grass clippings and don't overfeed your fish as this will only boost the nutrient input.

EXCESSIVE PLANT GROWTH

Sooner or later it will be apparent that some of the plants in your pond have become overgrown and need thinning. A little attention on a regular basis should help to minimise this, but, once a year you should remove excess growth and reestablish open water over about one third of the pond area. Do this in the autumn to avoid unnecessary disturbance.

Submerged plants can usually be raked out or cut below the surface with scissors or a scythe and then scooped out with a net. Be very careful though not to damage the liner! Also, with small blocks of plants it is easy to drag out the whole block causing untold disturbance. So don't be too heavy handed. Lily roots can be particularly invasive and may need cutting with secateurs. Don't be too hasty to dispose of this excess plant material. Always search through it to make sure there are no animals trapped in it. Also ask around to see if anybody is just setting up a pond and is looking for planting material, even if it is the wrong time of the year for planting.

Blanket weed is a very common problem in ponds but is in fact a filamentous alga. It forms unsightly mats on the surface of ponds and can smother plants. It should be raked out of the pond using a lawn-rake and disposed of. You can also collect it by rotating a stout stick in the weed so that it twists around like green candy-floss. You may have to be very persistent to beat blanket weed as even a small fragment can increase to choke the pond in a short space of time.

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SILT ACCUMULATION

After a number of years, the silt which naturally accumulates in ponds should be cleaned out. If you do this in late September or October you will cause a minimal amount of damage to the plants and animals living in the pond. You can slow down the accumulation process by covering the pond with netting in the autumn to keep out falling leaves, by removing plant material as it dies back each autumn and by regularly removing excessive growth.

Start by making a small, temporary holding pool from polythene sheeting (a child's paddling pool is an excellent alternative) and transfer some of the pond water and any plants and animals you want to save to it. Drain off the rest of the water from the pond using a siphon or buckets. The silt can then be scooped out using buckets or, if compacted with a spade. Again, be very careful not to damage the liner. Also, keep your eyes open for any animals which might be lurking in the mud.

Don't take out all of the silt, as a small amount left will help the pond to restore its natural balance. Refill the pond with water leaving sufficient space for the 'old' pond water. Leave it overnight for the suspended silt to settle out before returning the plants, old water and animals from the temporary pond.

ICE COVER

In Britain, ponds are unlikely to freeze solid unless they are very shallow. Ice rarely forms to a depth greater than 15-20 cm. Because light can penetrate all but the thickest ice, plants in the pond will continue to photosynthesise beneath the ice, albeit very slowly, and the animals living there should be in no danger. For practical purposes, ice is only a problem to ornamental fish which can be killed by the build up of toxic gases produced by the microbial breakdown of organic matter.

To dissipate these gases you will have to breach the ice cover, but never do this by breaking the ice. The shock waves can kill fish and you might damage the liner. Make a hole in the ice by standing a metal container on it, and pouring in boiling water (make sure that the container doesn't plunge straight through). Once you have a hole, to be of any value you should try to maintain the ice-free water, a small pond heater can help to do this.

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FISH DISEASES

As pointed out earlier, it is not possible in a leaflet such as this to go into detail on the specific diagnosis and treatment of the many diseases which may affect fish. For this you will have to consult one of the many specialist text books which are available or your local aquarist. However, it is important that you are able to recognise a diseased fish, as early diagnosis and treatment is half the battle.

Advanced symptoms of disease are easy to spot, the most obvious being the presence of dead fish sudden mass mortality is more likely to indicate pollution. Don't just remove the dead fish and turn your back on the pond. Others which are at a less advanced stage might be saved if appropriate action is taken. Initially, don't assume that death was due to fungal infection just because the fish looks like a ball of cotton-wool. Saprophytic bacteria and fungi will always colonise decaying tissue after death but are not necessarily the cause of death. Other obvious signs to look for are skin lesions, bloody patches, abnormal growths and bulges and spine deformation.

Less obvious physical signs include small specks or spots, milky turbidity of the skin, bulging eyes, clouding of the eyes, bulging scales, changes in colour, particularly paleness, sunken belly and frayed fins

In addition to physical signs, the behaviour of a fish can often give an early indication that all is not well however, you will only notice 'abnormal behaviour' if you are familiar with 'normal behaviour', so get into the habit of watching your fish, particularly at feeding times. Observe any suspect fish closely to make sure the abnormality is not just a temporary quirk. Is it maintaining a proper balance in the water? Is it tipping over, floating or sinking? Are the tail and fins held at normal angles? Is it slow and lethargic? Is it feeding normally or not? Is it breathing normally in a regular and relaxed manner or are the gill movements rapid and urgent (check all the fish in this case as it might indicate a deficiency of oxygen in the water)?

Once you have a list of symptoms you can set about diagnosis and treatment with the help of a text book or knowledgeable aquarist.

It is also worth noting that, like humans, fish are more likely to succumb to infection if they have been injured or if they are stressed due to inadequacies in their environment. Therefore you should not treat the symptoms in isolation but also look for the cause! Problems are often encountered in spring after the winter rigours or after stocking due to handling stress. Have you recently made any introductions to the pond, including plants? Have you made any changes to the management of the pond? Is the pond

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overstocked and choked with plants or silt? Are you over or under-feeding? Is the water being polluted - have you recently put down weed killer on the lawn? Does your cat sit on the edge clawing at passing fish? What is the weather like? Thundery weather can result in low dissolved oxygen concentrations which can result in abnormal behaviour and, in badly maintained ponds, even death of fish.

Consider all possible causes and correct them if you can - water sprayed onto the pond from a hose pipe can help to restore oxygen levels. A final point concerns feeding of fish. Few small ponds stocked with fish will be sufficiently well balanced to provide the fish with all the food they need so you may have to provide extra. Use a good quality feed, preferably one that floats, but do not provide too much. If it is not all eaten within about 5 minutes you are giving them too much. Only feed them during the warmer months of the year and as their appetite wanes. In the autumn, reduce the frequency and amount of food given. When the temperature falls very low and the fish stop feeding, resist the temptation to 'put a bit in, just in case'. Be ready to start feeding them again though when the water warms up in the spring. By this time, the fish will have used up all of their reserves and will be vulnerable to infection.

Many ponds, very often larger than the average 'garden pond', are found to have been neglected for many years. Consequently they may be filled with silt and other debris, overgrown with plants, many of a terrestrial origin, thereby attracting the flotsam-and-jetsam of modern society. Others may be leaking, a problem also encountered with the smaller garden pond.

Depending on the extent of the problem, the solution may involve just a short but intensive action plan or a long term, extensive restoration plan. A very useful source of reference in either case is the Waterways and Wetlands' handbook published by the British Trust for Conservation Volunteers (full reference given at the end of this section).

POND RESTORATION

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LEAKING

Ponds lose water naturally due to evaporation, usually at a fairly slow rate. Only by close observation over a period of time will it be possible to become familiar with this rate. If the rate of loss increases either slowly or dramatically, and there is no other explanation you should suspect a leak and investigate the matter further.

The ease with which a leak can be repaired depends on the lining material used and the nature of the leak. A butyl-rubber liner which starts to leak is unlikely to have degraded. The most likely cause is accidental damage which will almost certainly be localised - have you been weed cutting or clearing silt recently? Locating the damage will obviously mean draining down the pond but once found the damaged area is easily repaired using a patch of the same material

Patching kits are available commercially. PVC liners can be repaired in a similar way but you should be alert to the possibility of the liner having degraded and become brittle. Polythene liners are particularly vulnerable to degradation and although emergency repairs may be effected using mastic tape, any liner which shows signs of becoming brittle should be considered a 'write-off' and replaced. Don't discard the old liner though as it can be used to build a marsh habitat.

Concrete lined ponds are more difficult to repair, especially if they are badly cracked. Chiselling out the damaged section to provide a key for fresh concrete before filling can provide a short-term solution however, the structure will have been permanently weakened and the only satisfactory long term solution, short of taking out all of the concrete and starting again, is to line the pond with a flexible liner following the same principles set out in 'Making a Pond'.

Leaks from clay-lined ponds (older ponds, often referred to as 'natural', are inevitably man-made but lined with clay) may result from cracking which can occur if the pond is allowed to dry out or from damage during a cleanup operation. This is particularly easy to do when using a large excavating machine to clear a pond. If the damage is very minor, i.e. if the water level is going down only slowly and the pond is in no danger of drying out, the pond may 'self-seal' in a couple of years. However, for more serious damage the water level must be lowered and the clay re-puddled. Again, the BTCV handbook gives an excellent description of this technique and should be consulted.

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SILT AND DEBRIS CLEARING

This topic is fairly self-explanatory. Nevertheless there are certain points to remember when embarking on such work.

- (i) You will cause minimal disturbance to wildlife if you carry out any clearance work during the autumn, late October through to December being ideal. If the pond is very badly silted (to the point where it has virtually disappeared) or if it is very badly polluted, complete clearance in one year at any time is unlikely to cause much harm. In less badly affected ponds, partial clearance in any one year would be less damaging. This will enable plants and animals to colonize the cleared sections from those left intact. In any event, whether clearing wholesale or only bit-by-bit, you should rescue any plants and animals which you want in the restored pond.
- (ii) Other points to remember concern the silt. An area ten metres square and half a metre deep will yield in excess of sixty tonnes of silt, a couple of lorry loads. Can you dispose of this? It will also probably contain broken glass and rusting metal, so under no circumstances wade bare-foot.

Heavy articles such as logs and larger pieces of dumped rubbish can be dragged out using a winch and cable. In the process they can provide a useful tool for dragging out silt to a place where it can be shovelled. For less arduous tasks, spades and muck rakes should suffice.

Work in small areas starting near the edge and working towards the middle. It makes dragging much more difficult if you have trampled consolidated sludge into a liquid ooze. Dig or rake out to the required depth in that area before moving on. Make sure though that you don't break through the impermeable lining. Puddled clay may be grey, yellow or red/brown and may be covered by a layer of hardcore. If the pond is lined with butyl rubber or PVC, which may be hidden under a layer of soil as well as the accumulated silt, you will obviously have to be much more careful. A garden rake with a piece of board fastened across the tines can make a handy scraper to pull the silt out without damaging the liner.

STUDYING PONDS & POND LIFE



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Studying ponds and pond life can be a fascinating and rewarding exercise to all ages and abilities, from the primary school child to the university professor. Because ponds are fairly discrete microcosms in which a great variety of species can co-exist, they provide a valuable opportunity for studying the fundamentals of biology and ecology - life habits and tactics, nutrient cycling, trophic interactions, food webs etc - on a manageable scale.

There is no great requirement for technical expertise or expensive equipment although as in all such matters the more you learn, the more you will question and the greater will be your need for expertise and equipment. Help is at hand in the form of numerous books on ponds and pond life, some of which we have listed at the end of this section. These range from general texts to technical guides for identification. Use them and enjoy your study. Below are some points to help you on your way.

SOME BASIC CONSIDERATIONS

- (i) Make sure that you have permission to visit the pond for the purpose intended. A letter of authorisation can save arguments later.
- (ii) Avoid wanton damage - don't trample around the edge; choose a dry access as marshy areas are particularly vulnerable.
- (iii) Don't collect indiscriminately - try to make all of your observations alongside the pond so that you can quickly return any specimens to the water.
- (iv) Handle specimens gently as they are small and most are very fragile. A white plastic teaspoon will prove invaluable for handling.
- (v) Remember safety. The water may be deeper than you think - soft mud can increase the effective depth by half a metre or more. Never wade in bare feet - there may be broken glass, barbed wire and other sharp objects hidden in the mud.

EQUIPMENT

You can learn much by merely looking, listening, touching and smelling. In fact it is always a good idea to start any study on site with no equipment other than a notebook and pencil with which to record your initial observations. After that, basic equipment could include:

- (i) A pond net - pond nets can be bought or home made. For general purposes the size, shape and mesh-size of the bag are unimportant. It is important is that the frame and handle are strong. A broom handle and a stout metal frame are ideal. Don't use a bamboo cane and wire.

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- (ii) White tray - a white tray is useful for sorting the samples as animals stand out against a white background. A white plastic teaspoon will also be useful for handling small specimens and will enable you to isolate them for closer observation.
 - (iii) A hand lens - only buy a good quality hand lens (x 10 magnification). It will only cost a few pounds from an optician or stamp dealer and will last you a life time.

More advanced studies will require a microscope and, for chemical analyses, laboratory facilities (although an approximation of the acidity or pH of the water can be obtained using simple indicator paper or a soil test kit). The facilities available in secondary school science departments should be adequate for many such projects.

PLANNING

Most will be achieved if you carefully plan your pond study beforehand and establish some clear objectives to work towards. As a start to any project it is interesting to find out something about the pond's history. How old is it? What was it excavated for? You might also map the pond to indicate the different zones and perhaps prepare a cross-sectional profile - mark off the handle to your pond net in 5 cm gradations to measure the depth. You can then relate your observations on the pond's flora and fauna to its history and morphology.

A 'lucky-dip' can be interesting, but far more interesting are the answers to simple questions such as what sorts of plants and animals live in different parts of the pond? Do different sorts of animals live in association with different sorts of plants? What can the place an animal lives in tell us about the way it lives - how does it obtain oxygen, what does it eat etc? Do more species live at the edge or near the centre of the pond? You don't need to be able to identify all of the different species, merely to recognise them as being different.