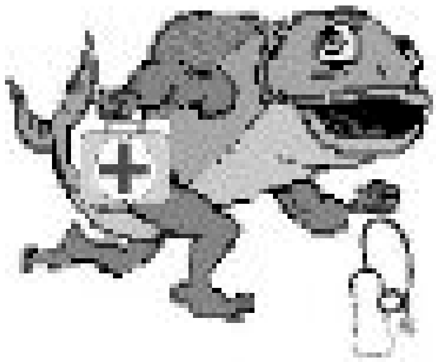
2004 AVA
Aquatic Animal Health

FISH VETTING ESSENTIALS



www.geocities.com/thefishvet

By Dr Richmond Loh
(BSc, BVMS)

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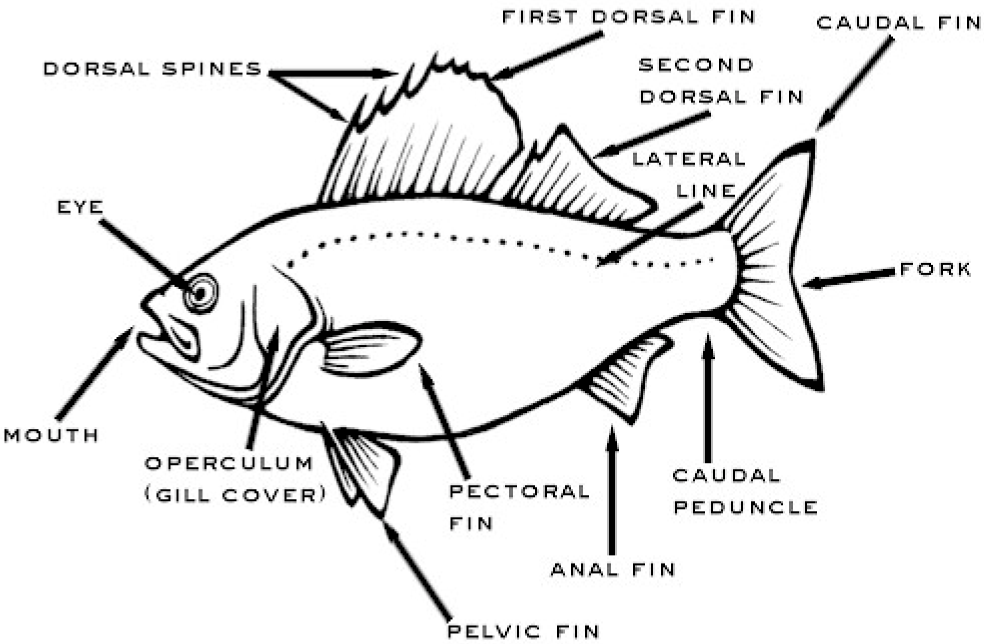
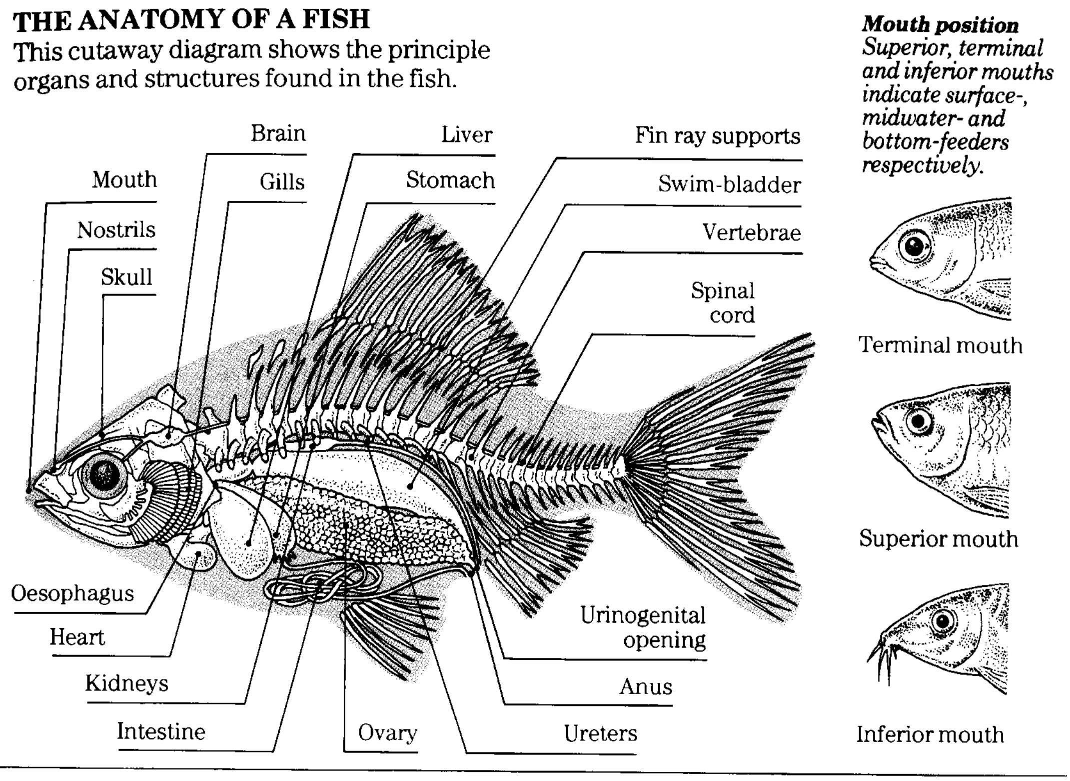
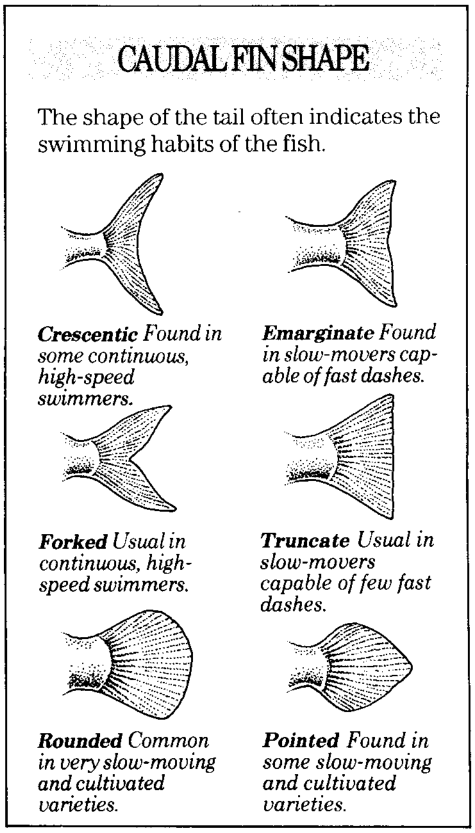
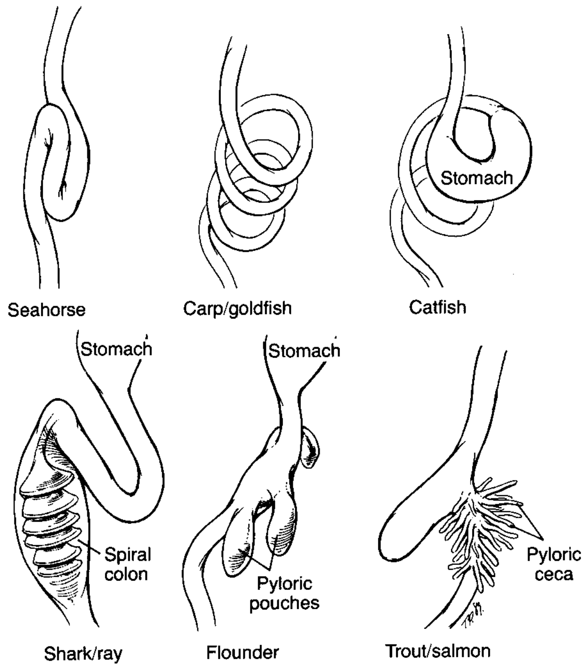
ANATOMY AND FUNCTION







Gastrointestinal tracts of fish.

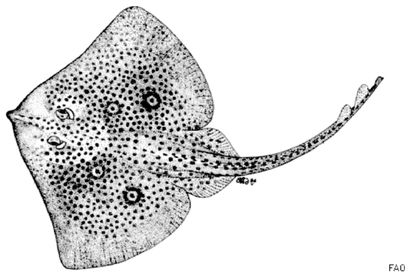


Body shapes

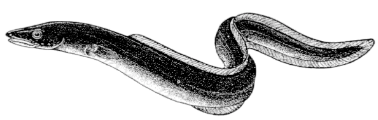
Fusiform

Laterally compressed

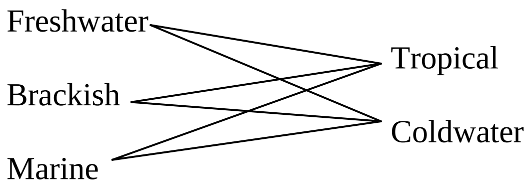
Dorsoventrally compressed



Eel form



AQUARIUM SET-UPS



Water requirements on the left hand side denotes the "saltiness" of the water and the headings listed on the right hand side denotes the temperature requirements. There can be intermediates to these and the best guide is to refer to a hobbyist's text for specific species requirements.

AQUARIUM EQUIPMENT

It is important to familiarise yourself with some of the equipment and terminology. It is simple and most are self-explanatory:

Fish tank/ aquarium
Heater (with thermostat)
Thermometer
Lights (incandescent, fluorescent, metal halide, other)
Filter
Air pump
Air stone
Plastic tubing, connections, valves
Cover glass
Gravel / shell grit
Water conditioner
Water test kits (ammonia, nitrite, nitrate, pH, hardness, specific gravity)
Protein skimmer (marine set-ups)

Some more advanced hobbyists may have:
UV steriliser
Ozone injector
Carbon dioxide injector
Reverse osmosis unit

FILTRATION

Classification:

Mechanical - removes large particulate matter by trapping (e.g. filter wool, pre-filters, etc.).
Chemical - removes dissolved wastes by chemical means (e.g. activated carbon, zeolite, etc.).
Biological - provides a substrate for nitrifying bacteria in order to remove nitrogenous wastes (e.g. filter sponge, ceramic beads, bio-balls).
*all types of filter units have, to a certain extent or other, all the above qualities.

Types available: internal box (filter wool mechanically filters the water, while the activated carbon absorbs wastes); undergravel (utilises the large area and volume of gravel to provide substrate for nitrifying bacteria to purchase); internal or external power filter & sponge filter (provides substrate for nitrifying bacteria and mechanically traps large particulate wastes).

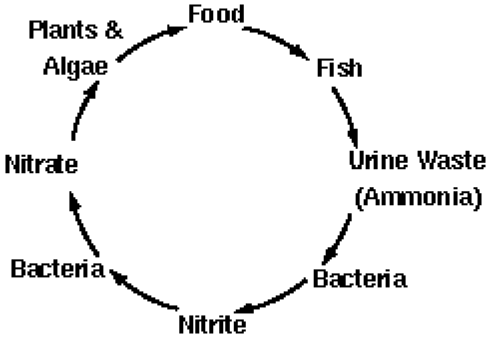
AERATION vs CIRCULATION

Circulation describes water movement. This is achieved by paddle wheels in large ponds or through the use of powerheads in aquarium set-ups. In such cases, gases can only exchange at the surface.
Aeration involves the 'injection' of oxygen/air into the water. This is achieved by air stones powered by pumps. Oxygen is able to dissolve and carbon dioxide evolve around each tiny air bubble. These rising air bubbles also creates a lift and thus circulate the water too.

NITROGEN CYCLE

The conversion of ammonia (the major excretory product of fish) to nitrate is termed the "Nitrogen Cycle".
Nitrifying bacteria grow slowly and take ~2-6 weeks to develop sufficient numbers to adequately filter the water. This time is called the "conditioning period". An established, well balanced aquarium should have no ammonia or nitirte.
In the natural environment, the end product (nitrate) will be incorporated into plants/algae. However, in the aquarium, this will accumulate in fish tanks unless it is removed by partial water changes.

#1



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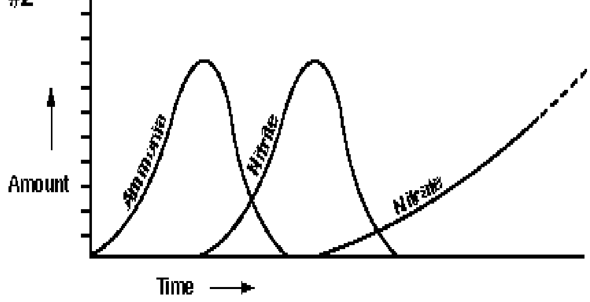

WATER PARAMETERS

Temperature

Fish, being poikilothermic, water temperature is a fundamental parameter that affects their health. These organisms all have specific temperature ranges within which they can live normally.
The availability of oxygen is directly affected by the temperature of a water body (salinity and the rate of oxidation of organic matter also affect oxygen availability).
Water temperature affects metabolism (metabolic rate), feed intake, growth, reproduction, physiological processes (affects the function of enzymes), disease immunity, movements and respiration rate. It also influences the susceptibility to potential toxic compounds and ammonia levels, as well as the bioaccumulation and detoxification and solubility of fertilisers.
Water temperature tolerances are specific to each species and are difficult to group into categories. But broadly speaking, tropical fish require 25-28 ^oC (usually require an aquarium heater) and coldwater fish require waters cooler than this (10-20^oC).

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pH

Abbreviation of potential hydrogen. Numerous biological processes depend on pH. It plays an important role in the blood system especially for oxygen diffusion. pH can indirectly affect fish through its effect on other chemical parameters. For example, low pH reduces the amount of dissolved inorganic phosphorus and CO_2 available for photosynthesis. In addition, low pH can result
in the solubilisation of potentially toxic metals from the sediments, while at high pH, the toxic form of ammonia becomes more prevalent. Phosphate, which is commonly added as a fertiliser, can precipitate at high pH. Large fluctuations are detrimental. Never change the pH by more than 0.5 per day.
pH also affects the toxicity of ammonia present in the aquatic habitat.
An important note when testing water pH, is that there are also small diurnal fluctuations due to the evolution of carbon dioxide by aquatic plants (given by the chemical equation $H_2O + CO_2 \Leftrightarrow H_2CO_3 \Leftrightarrow H^+ + HCO_3^-$). Water is most acid in the morning as the forward reaction is favoured. Therefore, test pH at the same time each day. These fluctuations can be minimised if there is sufficient buffering capacity of the water (see section on Carbonate Hardness).
pH can be increased by the addition of NaHCO, however, poor tank/pond hygiene (build up of organic material) is often the cause of low pH. It is important to check other water quality parameters (NB: biological filtration ceases at pH <).

pH levels & their consequences

1 3 4 5 6 7 8 9 12

- 3: Fatal to plants & animals.
- 5: Harmful to most plants & animals.
- 6: Suitable for plants & animals from tropical rainforest.
- 7: Favourable to most plants & animals.
- (between 8 and 9): Harmful to most plants & animals; favourable to some.
- 9: Suited to only a very few specialised species
- 12: Fatal to plants & animals.

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Ammonia

Ammonia (NH_3) is produced by fish respiration and by the decomposition of waste products (excessive organic matter and excessive feeding). It can be present as two forms: highly soluble toxic ammonia gas (NH_3), or the less dangerous ammonium ion (NH_4^+).
Ammonia is a strong cell poison and can cause damage to the gills at levels as small as 0.25ppm. Clinical signs include (but are not limited to) increased mucus production, red or bleeding gills, darkening of body colouration, 'gasp' for air at the surface, increased respiration rate.
The pH of water is an important factor that determines the ration of NH_3 & NH_4^+. When the pH is high, the ammonia is in its toxic for. Toxic ammonia will increase exponentially with increasing pH levels and temperature. Water test kits come with a chart so that you can determine whether toxic levels of ammonia is present.
Best treatment is an immediate large partial water change (25-50%).

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Nitrite

Nitrite (NO_2^-) is generated through the oxidation of ammonia by nitrifying bacteria. Elevated levels often occur during the early stages of setting up new aquariums and is in the process of undergoing the 'cycling' process. Full biological establishment of a new aquarium will commonly take approximately one month (double this time in marine set-ups). When an aquarium is fully established, no ammonia and nitrite should be present. A sudden spike in the nitrite usually means there is an imbalance in the system.
Nitrite causes the formation of methaemoglobin in the blood and causes respiratory compromise as it blocks oxygen uptake by the blood (similar to carbon monoxide poisoning in mammals). Treatment is by adding 1ppt NaCl (Cl^- will competitively inhibit NO_2^- uptake by the gill epithelium) or methylene blue and large partial water changes (25-50%). Vitamin C will also help. The filtration system should be checked. Nitrification process stops at pH <5. Nitrite is more toxic in soft water and at higher temperatures and marine fish and juveniles are most sensitive.

Nitrite levels & their consequences

0-0.2mg/L is ideal
$>$0.5mg/L is harmful
$>$1.6mg/L is lethal

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Nitrate

Elevated nitrate (NO_3^-) levels create considerable stress to fish and reduces their capacity to resist disease. Nitrate is the final by-product of organic and inorganic decay. In the natural environment, nitrate is removed through organic usage, however, in the closed system, nitrate will accumulate if not removed. Thus, high levels indicate pollution from prolonged waste build-up and partial water change is necessary.

Nitrate limits for:
Freshwater: 110ppm
Marine fish: 40ppm
Marine invertebrates: 15-20ppm

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<u>Hardness</u>

The concentration of dissolved salts affects the osmotic regulation systems in fish. There are two types of hardness: General Hardness (GH) also known as Total Hardness (TH); and Carbonate Hardness (KH) also known as Alkalinity or Temporary Hardness.

General Hardness (GH) is a measure of all chemically bivalent metal ions (primarily comprise of calcium and magnesium). These ions are important for skeletal growth. Excessively high GH will result in zinc deficiency cataracts and nephrocalcinosis. If GH is too low, deficiency syndromes like head and lateral line erosions (HLLE) and Hole in the Head disease may appear. GH should be ~150ppm for freshwater community fish and higher for live bearers and rift lake cichlids). Important note is that snails can drop GH as they consume it for their shell growth.

Carbonate Hardness (KH) is the measurement of the capacity for water to neutralise an acid (i.e. the buffering capacity). The alkalinity is primarily composed of bicarbonate ions (HCO_3^-) and carbonate ions (CO_3^{-2}). Carbonate Hardness is important to stabilise the water pH (pH becomes highly unstable in water with a KH <55ppm), is an important source of energy for nitrifying bacteria that that eliminate ammonia and nitrite and is used by plants for photosynthesis when carbon dioxide is absent. Desirable KH for freshwater fish (60-80ppm), for rift lake cichlids (120-200ppm) and marines (120-200ppm).
Water can be softened by the use of distilled water, rainwater, reverse osmosis water or using peat moss. Water can be hardened by adding limestone, shells, coral skeletons or Malawi salt.

Water requirements given in fish keeping texts may use one of three kinds of descriptors for water hardness:

Qualitative Descriptor	Degree hardness (^{o}dH)	Hardness (ppm) or (mg/L)	Milli equivalents (meq/L)
Very soft	0 - 4	0 - 70	0 - 1.4
Soft	4 - 8	70 - 140	1.4 - 2.8
Medium-hard	8 - 12	140 - 210	2.8 - 4.2
Fairly hard	12 - 18	210 - 320	4.2 - 6.4
Hard	18 - 30	320 - 530	6.4 - 10.6
Very Hard	>30	>530	>10.6

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Oxygen

Oxygen is vital for a healthy aquarium. The maximum oxygen carrying capacity of water is affected by the temperature (lower levels in warmer waters) and specific gravity (SG). Healthy systems should be >70% saturated, but as a general guide, fish need >5mg/L of dissolved oxygen.

Solubility of oxygen in water at different temperatures and SGs.

Temperature (^{o}C)	***Specific Gravity***			
	1.018	***1.022***	***1.026***	***1.030***
5	11.45	11.05	10.60	10.20
10	10.15	9.75	9.40	9.05
15	9.10	8.75	8.45	8.15
20	8.20	7.95	7.70	7.40
25	7.45	7.20	6.95	6.70
30	6.75	6.55	6.30	6.05

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Chlorine

Chlorine (Cl_2) is toxic and causes gill necrosis and is more toxic at lower pH. It is usually present in tap water at 0.5-2 ppm. Chlorine can also react with ammonia in aquaria, forming a more stable form - Chloramine ($Cl_2 + 2NH_3 + 2H^+ \rightarrow 2NH_4Cl$). This is equally as toxic. Chloramine may also be used by the council to disinfect the water. These chemicals can be easily removed by using chlorine neutraliser (sodium thiosulphate).

Chlorine levels & their consequences

>0.01 ppm → stress
>0.02 ppm → adverse effects seen
>0.04-0.1 ppm → death

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Salinity

Salinity is the measure of salt in a solution. Specific Gravity (S.G.) is the ratio of the density of a substance to that of water (i.e. relative density).

Classification of saline waters

Common term	**Scientific term**	**Salinity (ppt)**	**Specific Gravity (S.G.)**
	Hyperhaline	>40	
Sea-water	Euryhaline	30 - 40	1.024 - 1.030
	Polyhaline	18 - 30	
Brackish water	Mesohaline a	10 - 18	1.018
	Mesohaline b	1.84 - 10	
	Oligohaline	0.21 - 1.84	
Freshwater	Freshwater	<0.21	1.000

Seawater – special considerations

Effects of seawater collection and usage

Changes

When surface seawater is collected, most protozoans and invertebrates die, thus increasing the amount of organic matter.
Then bacteria proliferate and decrease the DO, increase the CO_2 concentration, decrease the pH.
If water becomes anaerobic, toxic substances will evolve.

For prevention of bacterial build-up,
water can be disinfected by ozonation or ultraviolet irradiation. This will also get rid of many disease-causing organisms.
Water should be filtered through 0.45um (or at least 1um cartridge or bag) to remove bacteria, phytoplankton and other larger organisms.

Long-term studies of water chemistry of recirculating aquaria found that:
Ca^{+2} increases (from egestion).
PO_4^{-3} increases considerable (from egestion).
K^+ increases (from excretion).
Mg^{+2} decreases (by ppt with PO_4^{-3}).
NO_3^- increases.
Alkalinity decreases because of the loss of Mg and accumulation of NO_3^-.
Organic substances increases.
pH decreases because of accumulating metabolic products.
DO capacity decreases.
CO_2 increases.

Long-term storage guidelines for seawater:
Remove the solids with a mechanical filter.
Control bacteria by cooling to 4^{o}C, ozonation or UV treatment.
Aerate the water to prevent stagnation.
Store it in the dark to prevent growth of algae.
Store it in inert containers to prevent contamination.
Avoid contact with metal.
Have a means of draining and cleaning the system.

FISH HEALTH

Signs of ill-health
Lethargy (abnormally quiet, unresponsive)
Hiding away in a corner
Fin clamping
Excessive slime/mucus on the skin
Flashing/scratching
Changes in body colouration
Spots/fluffy growths on the body
Lumps/bumps/nodules
Ulcers
Abdominal swelling
Protruding eyes
Discoloured eyes
Anorexia/wasting
Buoyancy problems
Fins fraying/rotting
Piping/gasping for air
Increased respiratory rate (observe pace of opercular movements)

MEDICINE CHEST

*Remember, medication is only a 'patch-up'. Need to identify the primary cause.

Skin injury / fungal growth protocol
Anaesthetise fish (Aqui-S, Alfaxan CD)
Debride/excise
Topical iodine (10-20% strength)
Topical Panalog cream ointment (leave on skin for 30-60 seconds to allow local absorption)
Seal wound with dental gel (Orabase)
Anti-inflammatory (Metacam)
Injectable antibiotic intramuscular (enrofloxacin - Baytril)

External parasites
Individual fish
Freshwater fish: Salt bath at 10-35g/L for 4-5 minutes or until fish is distressed.
Marine fish : Freshwater bath for 4-5 minutes or until fish is distressed.

Tank problem
Formalin: 0.015 - 0.025ml/L q3d, maximum 3 repeats.

Internal parasites
Metronidazole (available as Flagyl-S) is indicated for internal flagellates.
In water: 2.6-5.0mg/L
In food: 5-10mg/g of food.

Bacterial infection
Gram negatives constitute > 80% of bacterial infections in fish.
Enrofloxacin (available as Baytril-S) is the antibiotic of choice.
IM: 5-14mg/kg SID q2d, 3-5 rpts.
PO: 1% in food for 10-14d.

Q1.
What is the optimal water conditions for your fish patient?
a) temperature 25'C, pH 8.0, GH 20'.
b) temperature 28'C, pH 6.5, GH 8'.
c) temperature 25'C, pH 7.0, GH 18'.
d) temperature 28'C, pH 8.2, salinity 33ppt.
e) depends on the species.

A1.
The correct answer is (e), depending on the species. There is a wide variety of waters that fish come from and water parameters can vary markedly from one place to the next. (a) is the ideal water parameters for discus, (b) is for African cichlids, (c) is for the typical tropical freshwater community tank and (d) is for clownfish (tropical marine fish).

Q2.
What is the maximum stocking density for the following set ups?
a) tropical freshwater? ________cm/L
b) coldwater freshwater? ________cm/L
c) tropical marine? ________cm/L

A2.
a) 1cm/L
b) 0.5cm/L
c) 0.5cm/L

Q3.
What is the optimal water turnover rate in an aquatic system?

A3.
4-5 volumes per hour is adequate for tanks if they are not over stocked and weekly 25% water changes are conducted. 8-9 volumes per hour is necessary for ponds and fish that produce more wastes (e.g. oscars and other carnivorous fish). So, if you have a 1000L tank, you will require a power head that will pump at least 4000L per hour.

Q4.
Name the three major categories of filtration available and give examples of each.

A4.
Mechanical: filter wool.
Biological: bioballs, ceramic beads, plastic beads.
Chemical: charcoal, ammonia sorb.
Some filters are a combination of any or all of the three. Be familiar with these and how they work.

Q5.
Explain the N-cycle using a diagram.

A5.
Fish/invertebrates excrete --> NH_3 --Nitrosomonas--> NO_2 --Nitrobacter--> NO_3 --algae/plants/water change--> removed.

TheFishVet

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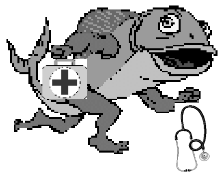
AQUARIUM PET ADVICE FORM



SUBMITTER DETAILS

Name ……………………………………………………………………….
Address ………………………………………………………………………..
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E-mail …………………………………………………………………….

Date ……………………………………………
Phone (H) ……………………..…………..
(W) ………………………………...….
Mob …..……………………………...……

FISH DETAILS

Name ………………………………………………………..
Species…………………………………………………………
……….……………..……………………………………………
……………..……………………………………………….
Size: ….…….mm **Weight** : ….....…. g **Age**: ………..
Tank mates & population size
………………………………………………………………….
……………...……………………………………………….
…….….…………………………………………………….
Duration of problem………….days/weeks

Tank dimensions ………………………..…………….

Sex (circle) Male Female Unknown

WATER QUALITY PARAMETERS

PRELIMINARY TESTS

NH_4^+ ……………mg/L
NO_3^- …………...mg/L
NO_2 ……………mg/L
pH …………………
Temp ……………..°C
Frequency of water changes
…………………
% water change ………..

ADDITIONAL TESTS

PO_4^{-3} ..………..……mg/L
Ca^{+2} ………..……..mg/L
Fe (NC) ….……..……mg/L
(C) ……..……...mg/L
Hardness
(G) ….………….…mg/L
(CO_3^-) ………….mg/L
Cl_2 ………….……….
Cu^{+2} …………………
Other ………………..

DISEASE HISTORY

Stress factors (circle)	new fish	maturation	overcrowding	temperature	anoxia	algae	aggression

Water data (specify)	freshwater	seawater	brackish	SG ……… or salinity ….……%
Filter type	under-gravel	canister	trickle	other ……………………….…..
Aeration	air pump	power head		other ……….……………….……..
Substrate	gravel (rough / fine)	shell grit	pebbles	other …………………………
Furnishings	plant cover …….%	bog wood	caves	other ………………………..……
Lighting	incandescent	fluorescent	metal Halide	other ……………….………..
Miscellaneous	heater	protein skimmer	UV/ozone	other ………………………….
Diet	…….			

DISEASE HISTORY

Signs of disease (circle)	Loss appetite	sudden death	loss of balance	wasting/ pin head	fin/tail rot	skin lesion/ulcer	gill lesion/ nodule/patch	exophthalmia/ blood spot
	Muscle lesion	swollen abd.	dropsy	lethargy	darken	**Other** ………………………………………… …………………………………………		

Any new acquisitions (fish, plant, furniture)? ………………..…………………………………………………………..
……..
……..
……..
The last disease outbreak & any treatments given recently? ………….………………………………….……
……..………..
……..………..

History ………..
……..
……..
……..

Clinical Examination …………………………………………………………………………………………….
Skin ………..
Fin …..……..
Opercula ..………………………………………………………………………………………….……………..
Gills ..………..
Eyes ..………..
Lateral line ……………………………………………………………………………………………………..
Mouth ………..

Other comments ……………………………………………………………………………………………………
……..
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……..

DIAGNOSIS & COMMENTS

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EXTRA TESTING REQUESTED

…….……
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REFERENCES

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Stoskopf, MK (1993) **Fish Medicine.** Saunders Company.

Disclaimer:
The information contained in the following pages are from much research and compilation, and as such, there are no specific references. By all means not an exhaustive resource, but may be a quick and useful first point of reference. To the best of my knowledge, the information contained herein is correct.
Dr Richmond Loh