1 Course admin

Aim of the course

To provide a scientific basis for the rational use of drugs in animals.

Course Objectives

By the end of the course you should be able to show:

• a sound understanding of the effects, mechanism of action and uses of the major groups of drugs which will allow you to use these drugs to treat animals safely and effectively.

• an awareness of drugs which are likely to be used in the near future.

• how and where to obtain further information on drugs.

• a sound understanding of pharmacokinetics and how these are used to ensure that an animal receives the correct dose of drug.

• an ability to evaluate scientific and clinical reports of drug trials and apply this to veterinary practice.

• a knowledge the law relating to the veterinary use of drugs in New Zealand and the responsibilities of the veterinary surgeon.

• a knowledge of how to diagnose and treat common causes of poisoning in animals.

Staff

The course organiser is Dr. Paul Chambers (office 6.22 (on level 6 in the Vet Tower)), telephone 7438, e-mail J.P.Chambers@massey.ac.nz). If you have any problems or suggestions for the course, contact him (or leave a message in the Clinic Office). Lectures will be given by several staff of the Institute of Veterinary, Animal & Biomedical Sciences.

Website

`http://calve.massey.ac.nz/pharm/index.html`

Check this regularly as it contains the most up to date info on changes to lectures etc.

Why bother?

Pharmacology - the study of drugs - is probably the most important (and certainly the most interesting) subject you will study as part of the vet course. When you qualify, no matter what sort of veterinary work you do, you will need to know something about drugs.

In general practice, when you are presented with an animal, you have a number of options:

1 - do nothing. This is the commonest option to avoid pharmacology, but is not very popular with clients, particularly when you charge them lots of money for it.

2 - give drugs. Most common, and the basis of medicine.

3 - surgery. Most animals will not stand still while you stick the knife in unless you give them anaesthetic or analgesic drugs first.

4 - alter the diet. Often involves food supplements, which are well nigh indistinguishable from drugs.

5 - euthanasia. Usually from an overdose of drugs.

On a more negative note, you are most likely to get into trouble in practice through misusing drugs - failure to tell clients about side effects is very common. There's no getting away from pharmacology!

Assessment

There will be a computer marked test consisting of multiple choice questions at the end of each semester. These are designed to test if you have a broad knowledge of pharmacology, so do not be disappointed if you can't answer them all. I will be surprised (and pleased!) if anyone gets 100%! These will be administered using WebCT, and can be taken over a period of several days. Details will be announced nearer the time.

There will also be a WebCT therapeutics test at the end of semester 2. In this, you will be given case scenarios and a list of possible options for treatment to choose from. This is designed to represent the normal situation in practice, where you have a limited number of treatment options and have to choose the correct one first time.

Example exam questions are in the study guide and on the website. Practise with these before you do the real tests!

Assessment summary

Semester 1

WebCT MCQ	10%	end semester 1
team essay	15%	15th May 2009

Semester 2

WebCT MCQ	20%	end semester 2
WebCT therapeutics MCQ	30%	end semester 2
Team essay	25%	2nd October 2009
Total	**100%**	

Details will be posted on the CALVE website.

As with all exams, read the instructions first!

The pass mark will be 50% overall. The "average" student, if such an animal exists, can expect to get about 60%.

How much do you need to know for examinations?

It is not possible to rote learn a therapeutic recipe for every possible disease in every possible species you might encounter. It is important that you can rationally choose appropriate therapy for a condition with which you have no previous experience. This course should provide the initial structured learning which will enable you to both develop the skills and to obtain the knowledge necessary to become competent in the treatment of animals with drugs.

You will come across lots of drug names. **Do not try to learn them all!** It is worth trying to classify these into several groups:

emergency drugs - you should know what these drugs do, when to give them and at what dose. Fortunately only adrenaline, morphine, diazepam and iv fluids fall into this category, and the choice and initial dose rate of fluid is not critical.

commonly used drugs - you should know what these drugs do and when to give them.

rarely used drugs - you should know that these exist and where to get more information about them

The examination is designed to test the **application** of knowledge gained through the course, primarily within realistic common case scenarios encountered in veterinary clinical practice. This means that you must be able to **apply** your knowledge, not just regurgitate it. If you have a working understanding of the study guide and some common sense, you should pass easily. (You have to try hard to fail!!) If you memorise the whole study guide, you may get up to 90%. If you want to get 100%, you will have to read around the subject, including the more scientific journals.

These notes are designed as a reference and contain more detail than is required to pass the examinations. **Attempts to memorise them are a sign of stupidity**.

There will be no mid term exam. You are expected to assess how you are getting on by answering the practice questions at the end of each chapter and marking them yourself using the answers at the back, or using the same questions on the web site - the computer will mark them for you.

Work Groups

The class will be asked to divide itself into groups of four. To be a successful vet in practice, you must be able to work in a team and be able to delegate work to others. During the year, the material presented in formal lectures should be revised through group discussion of cases included at the end of most sections of the notes. The primary purpose of these work groups is to help you develop problem solving, reference searching and decision making skills necessary for competent therapeutics. The work groups will also help your learning of the course material, and help you develop a sense of the priorities to attach to different parts of the curriculum.

The groups are expected to write one assignment each semester.

Semester 1 assignment

In the first semester, each group will be given the titles of two papers, one scientific and one clinical, covering different aspects of the same subject. You should go to the library, find the papers, read them closely, decide on the major findings, reliability and relevance to veterinary medicine and write a critical essay on the papers (**3000 words**). The object of the exercise is to examine the major findings of the papers and their clinical relevance. You will be expected to comment on the experimental design and the authors' interpretation of their results. This involves obtaining some background knowledge about the subject, but is mainly a matter of careful thought.

Ask yourself a number of questions:

What are the authors trying to show?

Is the measure of outcome appropriate?

Are there suitable controls?

Are the numbers of animals sufficient to draw meaningful conclusions from the results?

Are the statistical tests used appropriate?

Are the results statistically or clinically significant?
Are the conclusions justified by the data?
How do the results compare with other studies?
How do the findings relate to practice in NZ?
Is the paper worth reading?!

How you write your essay is up to you. You may decide to split the papers up into their component parts and have each person write one part, or you may decide to have different people write about the good points and bad points of each paper. If you do this, though, good proff reading at the end is esential. Whatever way you do it, the group's essay should be concise, incisive and interesting.

The essay should be written on a word processor and emailed to Paul Chambers by **Friday 15th May**. If you do not get an acknowledgement - check with him!

This essay counts for 10% of your marks. It will be assumed that everyone has contributed equally - it is up to you to ensure that this happens.

Semester 2 assignment

In the second semester, the groups will also be expected to research and write a major review of a topic related to pharmacology. This will build on the skills you used in semester 1 in your review of papers. You will have to go through a similar process but do not need to write it all down. In the dissertation, you only need to include your conclusions after looking at the evidence, for instance, "Smith (1989) compared drug x and drug y, but inadequate controls and a small number of animals mean that no firm conclusions can be drawn from this work.".

Dissertations should be written as a publishable quality short review paper and consist of (i) Summary, (ii) Introduction, (iii) Main Discussion, (iv) Conclusions, (v) References.

This essay will require quite a lot of work and should not be left until the day before the due date!

Some handy hints on writing your dissertation

Choosing a subject

This is worth some thought. Ideally it should be a subject about which there are both scientific and clinical papers published. Choose a narrow topic and examine it in depth rather than taking a superficial look at a broad subject, but on the other hand do not choose a subject that is so esoteric that only one paper has been published about it! You will be expected to include all the relevant papers on the subject in your review.

Try to avoid vaccines and immunology, as they come under Microbiology rather than Pharmacology. You do not have to confine yourself to purely veterinary pharmacology; anything from basic science to human use of drugs can be considered.

You may get ideas from cases you have seen in practice, or from personal experience. We will attempt to guide you but the choice of subject is yours. One approach is to compare a new or experimental treatment with an established treatment for a specific condition, another approach is to look at all aspects of a new drug and suggest possible uses in veterinary practice.

Title

This should be concise but convey as much information as possible, including the species where appropriate.

Introduction

(1page of A4 maximum)

This should contain a concise statement of the problem. The objective of treatment should be clearly defined. If you are examining a new drug then it should be compared with something, usually conventional treatment. This should be briefly described, including any problems encountered. You should say a bit about the new drug and why it might be better than conventional treatment. This should all form a coherent story leading up to the main discussion.

Main discussion

This is where you should examine the evidence in detail. If you are looking at a new drug you should describe its mechanism of action. You should be able to predict its therapeutic and side effects from this, even if they are not reported.

Next look at clinical trials. In veterinary pharmacology, these are usually appallingly badly done. Apply the same sort of analysis as you did for the semester 1 disseration. You do need to write all this down : just say what you thought the papers showed. Make sure you search the literature for all the relevant papers!

Conclusions

These should be **your** conclusions drawn from an examination of the evidence. They may not necessarily be the same conclusions as the authors of some of the papers. You should be able to defend your conclusions if asked about them.

References

These should follow the NZVJ format: `http://www.vetjournal.org.nz/pub.html`

Avoid non-peer reviewed references if possible. If you cannot find any better reference than this study guide, you have not been searching hard enough!

The purpose of references is to allow the reader to look up the original work: if they are not written in such a way as to allow this then they are merely a waste of paper.

Presentation

The dissertation **should not exceed 4,000 words in length** (excluding references). Try to be concise. They should conform to the style required for the New Zealand Veterinary Journal (`http://www.vetjournal.org.nz/pub.html`)

During your research for the dissertation, you will have read your way through a lot of turgid crap. Try not to add to this. Follow the rules of style written by George Orwell many years ago:

• Never use a metaphor, simile or other figure of speech which you are used to seeing in print.

• Never use a long word where a short one will do.

• If it is possible to cut out a word, always cut it out.

• Never use the passive where you can use the active sense.

• Never use a foreign phrase, a scientific word or a jargon word if you can think of an everyday English equivalent.

• Break any of these rules sooner than say anything outright barbarous.

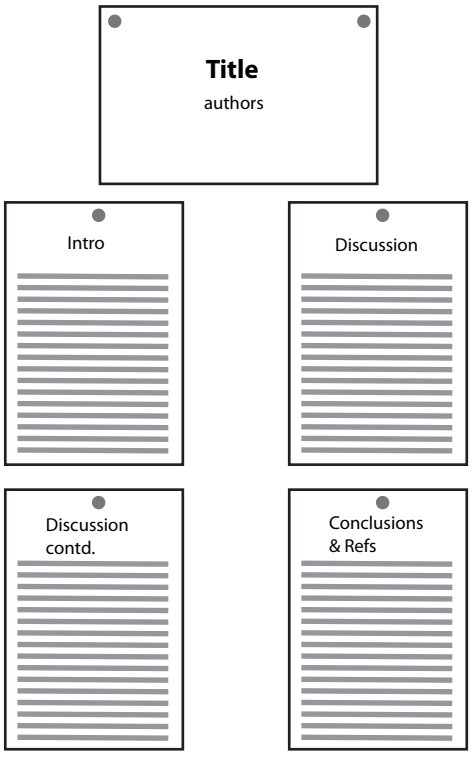
Organisation

You will work in teams of three or four and submit a single dissertation for the team. Marks will be allocated on the assumption that each member of the team has contributed equally to the dissertation; it is up to the team to ensure equitable distribution of the work.

In order to allow the rest of the class to benefit from your work, each team will be expected to present a poster of their work and be available to answer questions about it. Posters should consist of pages of A4 paper; one each for the title and authors, introduction, conclusions and main references, and two for the main discussion. The writing should be large enough to be read easily from a distance (at least 18 point). Do not go overboard with these posters, they should involve a minimum of extra work. However, if you want you work to be admired by everyone, email me your poster and I will put it on the website.

The dissertation should be emailed in by Friday 2nd October. This should give us time to mark them and hand them back before the exams. This does not mean that you do not have to do any work on it until the end of September - get started as soon as you can. Come and talk to me as soon as you have any ideas about what you want to to so that I can point you in the right direction.

The poster presentation will be in the foyer instead of the lecture on 29th September (but watch the notice board for changes). At least one person from each group will be expected to man their poster to answer questions about it.



Poster layout suggestion - how you do it is up to you but this is probably simplest. Loose sheets of A4 pinned to the notice board are perfectly adequate. The object of the excerise is to convey information, not create a work of art.

Analysing evidence

These assignments are designed to make you think about the evidence (or lack of it) behind clinical practice. "Evidence based medicine" has become the watch word in human medicine, but has not caught on yet in veterinary medicine. When you give a drug to an animal, it is likely to have both good and bad effects. You are expected to balance these and ensure that the good effects outweigh the bad. You must have some rational basis for this decision - "but Chambers said, back in the good old days when I was a student..." is unlikely to wash when the owner wants to know why their animal has died.

"Evidence" comes in several different forms:

1. **Randomised controlled trial** - best but practically non existent in veterinary medicine.
2. **Non-randomised controlled trial** - commoner.
3. **Cohort / case controlled studies** - rare
4. **Case series** - common, though single cases are commoner.
5. **Expert opinion** - commonest in veterinary medicine. Most of this study guide is composed of expert (ie, my) opinion. Remember that "experts" (even me) can be wrong!
6. **Traditional practice** - remarkably resilient even in the face of evidence that it is harmful.

Drug company marketing and web sites can fall into any of these categories, but tend towards the bottom of the list!

What you really need to know is what your drug will do to the animal you want to treat, but there is no way of answering this definitively without giving the drug. The next best thing to know is what the drug does to the mythical "typical" animal. In human medicine, this is often expressed as the "number needed to treat", or the number of animals you would have to treat to see a useful effect. If the drug works every time, the NNT is 1, if it only works in one animal in 20, the NNT is 20. The "number needed to harm" is calculated in the same way. These numbers are usually calculated from metanalyses of large numbers of controlled trials, so they are not often used in veterinary medicine (yet?).

The ultimate object of the exercise is to develop a way of using drugs which provides the best outcome for the animal and the vet. After you have gone through the process described below, you will realise that it is not usually practical to do this in general practice. The medical profession has gone some way to writing evidence based guidelines for practitioners (eg, `http://www.nzgg.org.nz/library.cfm`). This process is only just starting for vets. You can make better use of these sort of guidelines if you have some idea of what goes into them.

You have to be able to give appropriate weight to different pieces of evidence and be able to apply it to real situations. You may be surprised at how little evidence there is to support widely used treatments.

Lectures

	Basics			
1	introduction	Paul Chambers	24th February	2pm, WB1
2	receptors	Paul Chambers	24th February	3pm, WB1
3	drug - receptor interactions	Paul Chambers	26th February	8am, SSLB1
	Pharmacokinetics			
4	absorption	Paul Chambers	27th February	11am, WB1
5	distribution	Paul Chambers	3rd March	2pm, WB1
6	metabolism	Paul Chambers	3rd March	3pm, WB1
7	elimination	Paul Chambers	5th March	8am, SSLB1
8	residues	Paul Chambers	6th March	11am, WB1
9	toxicology basic principles & kinetics	Kathy Parton	10th March	2pm, WB1
	Peripheral nervous system			
10	cholinergic transmission	Paul Chambers	10th March	3pm, WB1
11	neuromuscular junction	Paul Chambers	12th March	8am, SSLB1
12	adrenergic transmission	Paul Chambers	13th March	11am, WB1
13	eye	Craig Irving	17th March	2pm, WB1
14	autonomic nervous system toxicology	Paul Chambers	17th March	3pm, WB1
15	bladder and uterus	Paul Chambers	19th March	8am, SSLB1
16	respiratory pharmacology	Paul Chambers	20th March	11am, WB1
17	respiratory toxicology	Kathy Parton	24th March	2pm, WB1
18	autacoids	Paul Chambers	24th March	3pm, WB1
19	gut pharmacology	Paul Chambers	26th March	8am, SSLB1
20	bloat	Kathy Parton	27th March	11am, WB1
21	gut toxicology	Kathy Parton	31st March	2pm, WB1
22	liver toxicology	Kathy Parton	31st March	3pm, WB1
	Central nervous system			
23	central neurotransmission	Paul Chambers	2nd April	8am, SSLB1
24	pain	Paul Chambers	3rd April	11am, WB1
25	local anaesthesia	Paul Chambers	7th April	2pm, WB1
26	opioids	Paul Chambers	7th April	3pm, WB1
27	other analgesics	Paul Chambers	9th April	8am, SSLB1
28	sedation & general anaesthesia	Paul Chambers	28th April	2pm, WB1
29	injection anaesthetics	Paul Chambers	28th April	3pm, WB1
30	inhalation anaesthetics	Paul Chambers	30th April	8am, SSLB1
31	anticonvulsants	Paul Chambers	1st May	11am, WB1
32	behaviour altering drugs	Vicki Erceg	5th May	2pm, WB1
34	drug abuse	Paul Chambers	5th May	3pm, WB1
35	CNS toxicology 1	Kathy Parton	7th May	8am, SSLB1
36	CNS toxicology 2	Kathy Parton	8th May	11am, WB1
37	toxicology - paralysis	Kathy Parton	12th May	2pm, WB1
38	CNS toxicology 3	Kathy Parton	12th May	3pm, WB1
39	CNS toxicology 4	Kathy Parton	14th May	8am, SSLB1

This timetable may well change! Check the notice board / website for up to date info!

	Cardiovascular system			
1	drugs for heart failure	Paul Chambers	13th July	8am, SSLB5
2	sympathomimetics	Paul Chambers	13th July	9am, SSLB5
3	ACE inhibitors	Paul Chambers	16th July	8am, SSLB1
4	digitalis	Paul Chambers	17th July	11am SSLB3
5	anti-arrhythmics	Paul Chambers	20th July	8am, SSLB5
6	diuretics	Paul Chambers	20th July	9am, SSLB5
7	kidney toxicology	Kathy Parton	23rd July	8am, SSLB1
8	blood	Paul Chambers	24th July	11am SSLB3
9	anticoagulant rat poisons	Kathy Parton	27th July	8am, SSLB5
10	fluids	Paul Chambers	27th July	9am, SSLB5
11	fluids	Paul Chambers	30th July	8am, SSLB1
	Inflammation and hormones			
12	corticosteroids	Kathy Parton	31st July	11am SSLB3
13	corticosteroids	Kathy Parton	3rd August	8am, SSLB5
14	NSAIDs	Paul Chambers	3rd August	9am, SSLB5
15	immunomodulators	Paul Chambers	6th August	8am, SSLB1
16	anticancer drugs	Paul Chambers	7th August	11am SSLB3
17	thyroid & pancreas	Paul Chambers	10th August	8am, SSLB5
18	hormonal growth promoters	Kathy Parton	10th August	9am, SSLB5
19	sex hormones	Tim Parkinson	13th August	8am, SSLB1
20	sex hormones	Tim Parkinson	14th August	11am SSLB3
	Skin			
21	antiseptics and disinfectants	Paul Chambers	17th August	8am, SSLB5
22	topical drugs	Paul Chambers	17th August	9am, SSLB5
	The law			
23	the law	Paul Chambers	20th August	8am, SSLB1
24	prescriptions etc.	Paul Chambers	21st August	11am SSLB3
	Antibiotics			
25	antibiotic therapy	Kathy Parton	7th September	8am, SSLB5
26	resistance	Paul Chambers	7th September	9am, SSLB5
27	penicillins & cephalosporins	Kathy Parton	10th September	8am, SSLB1
28	tetracyclines & macrolides	Kathy Parton	11th September	11am SSLB3
29	aminoglycosides	Kathy Parton	14th September	8am, SSLB5
30	sulphonamides	Kathy Parton	14th September	9am, SSLB5
31	fluoroquinolones & nitroimidazoles	Kathy Parton	17th September	8am, SSLB1
32	infections of systems	Kathy Parton	18th September	11am SSLB3
33	production enhancers	Paul Chambers	21st September	8am, SSLB5
34	case discussions	Kathy Parton	21st September	9am, SSLB5
35	antifungals & antivirals	Kathy Parton	24th September	8am, SSLB1
	The rest			
36	practical issues	Kathy Parton	25th September	11am SSLB3
37	miscellaneous toxicities	Kathy Parton	28th September	8am, SSLB5
38	practical toxicology	Kathy Parton	28th September	9am, SSLB5
	poster presentation		2nd October	11am, Foyer

Textbooks

These books vary from just very expensive to mind-bogglingly expensive - it is not necessary for you to buy them but you may want to consult them in the library. **This study guide has been designed as a reference to save you having to spend lots of money on textbooks.**

Veterinary pharmacology books

Brander, Pugh et al: Veterinary applied pharmacology and therapeutics 5th ed (1991)

This is a reasonable textbook but rather out of date.

Madison, Page & Church (eds) Small animal clinical pharmacology (2001)

A multi-author book which attempts, reasonably successfully, to be both an undergraduate pharmacology book and a clinical reference text. Not cheap.

CMPMedica Ltd: IVS Annual (2009)

A collection of most (but not all) of the package insert information for veterinary drugs available in NZ. Useful as a veterinary reference book to find out what's available. For human drugs you need to look elsewhere (e.g. MIMS). Most of the veterinary info should soon be available on the www at: `http://www.nzfsa.govt.nz/acvm/registers-lists/acvm-register/index.htm` although do not expect it to be in a user friendly form.

Bishop (ed) The Veterinary Formulary 5th ed (2000) & 6th ed (2005)

A very useful book organised on a systems / therapeutic indication basis. Dose rates for veterinary drugs and human drugs commonly used in animals. Although published in Britain, the 5th ed also covers European, American, Australian and NZ drugs, but the 6th only covers UK ones. As a general rule, drugs available here are a subset of those available in Britain. Good book but expensive.

Plumb: Veterinary Drug Handbook 4th ed (2002)

Excellent reference for dose rates, indications, contra-indications and toxicity, This is a collection of dose rates from most reputable veterinary medicine texts and from some refereed articles. It also includes some human drugs used in animals. It is organised alphabetically by drug name, so it is not much use for finding out what drugs can be used for a particular problem. The information is well referenced, so you can go to the primary source if you wish. However, some drugs commonly used here are not available in the USA, so are not included in Plumb. This is currently the cheapest of the useful reference books.

Adams: Veterinary Pharmacology and Therapeutics 8th Ed (2001)

Comprehensive but exorbitantly expensive. Becoming rather dated now - worth consulting occasionally. Good for weight lifting.

Bonagura: Kirk's Current Veterinary Therapy Small Animal Practice

Current Veterinary Therapy Food Animal Practice

Despite the names, these are a cross between a medicine and pharmacology book. They are written as clinical reviews of specific subjects, and contain much useful clinical information, backed up by a little science. However, they are not as current as the title suggests. There are tables of drug doses at the back.

For antibiotics only (covered in second semester):

P**rescott, Baggot and Walker, Antimicrobial Therapy in veteriny medicine. 3rd ed. Iowa State University Press (2000)**

Probably the most comprehensive book on veterinary antibiotics. Worth getting out of the library but not worth buying.

Cooper (Ed): Antimicrobial prescribing guidelines for veterinarians 2nd ed (1999)

Useful reference for antimicrobial therapy. Set out on an species / organ systems and disease basis which makes it easy to use and apply. Heavy Australian emphasis which is not always appropriate for this country - possums are unlikely to get antibiotics in NZ!

Human Pharmacology Books

These are useful for a basic understanding of pharmacology, but do not cover all you need to know.

Note that the library has lots of human pharmacology books for nurses, which are of very little use to vets.

Goodman and Gilman: The pharmacological basis of therapeutics 11th ed (2005)

This gives very comprehensive information about drugs, from chemical and pharmaceutical information right through mechanism of action to clinical human toxicity. It also provides a comprehensive review of physiology for each mechanism of drug action and is therefore also a very good physiology text. This book is expensive, but would be a valuable investment for anyone with an interest in physiology or pharmacology.

Rang, Dale, Ritter and Moore: Pharmacology 6th ed (2007)

A very easy to read book with excellent clear diagrams. Probably the best book for a clear explanation of mechanisms of action of the drugs covered. **The best value for money.**

The **British National Formulary** is a good (and cheap) source of information on human drugs. Nearly all the human drugs available here are available in the UK (although the reverse is not true). Format the same as the Veterinary Formulary. The BNF is also free on the web at: `http://www.bnf.org/bnf/bnf/current/openat/`

The **Monthly Index of Medical Specialities** (MIMS) is the human version of the IVS, and contains basic information on most human drugs available in NZ. It is very expensive to buy, but is a useful reference in practice. The full data sheets are available at `http://www.medsafe.govt.nz/profs/Datasheet/dsform.asp`

Martindale's Extra Pharmacopoeia is an excellent reference on human drugs and has some veterinary information,

but is too expensive to buy. Good for weight lifting.

Toxicology books

Parton, Bruere & Chambers, Veterinary Clinical Toxicology, 3rd ed. (2006) Massey University, Veterinary Continuing Education publication no. 249, Palmerston North

The definitive book on toxicology in NZ. It only costs peanuts to students, but if you can't afford this, it (plus lots more toxicology stuff) is available absolutely free at `http://calve.massey.ac.nz/pharm/tox-Site/index.html`

Other books

Much information on veterinary therapy can be gleaned from medicine texts, such as Ettinger's 'Textbook of veterinary internal medicine'; Blood Henderson and Radostits 'Veterinary Medicine'; Lorenz and Cornelius's 'Small animal Medical Diagnosis'; and the Merck Veterinary Manual.

The Merck Index (not to be confused with the human or veterinary **Merck Manual**) is a good source of chemical information and references for drugs.

Some drug doses are given for reference but you are not expected to know them at this stage. References for doses: IVS annual, Bishop "The Veterinary Formulary", Plumb "Veterinary Drug Handbook".

Journals

The ***Journal of Veterinary Pharmacology and Therapeutics*** is the main veterinary pharmacology journal. However, most pharmacology is published in the general veterinary journals such as the *Veterinary Record* and the *Journal of the American Veterinary Medical Association*, or research journals such as *Research in Veterinary Science*. Even the *New Zealand Veterinary Journal* sometimes publishes papers on pharmacology. You can get electronic versions of all these from the Library website.

The scientific pharmacology journals are useful: the ***British Journal of Pharmacology*** and the ***Journal of Pharmacology and Experimental Therapeutics*** are worth looking at. There are also specialist journals such as ***Pain*** which covers scientific, human clinical and occasionally veterinary clinical work.

New Scientist often has short articles on new treatments.

And finally...

The most important point to remember is that

pharmacology is fun!!