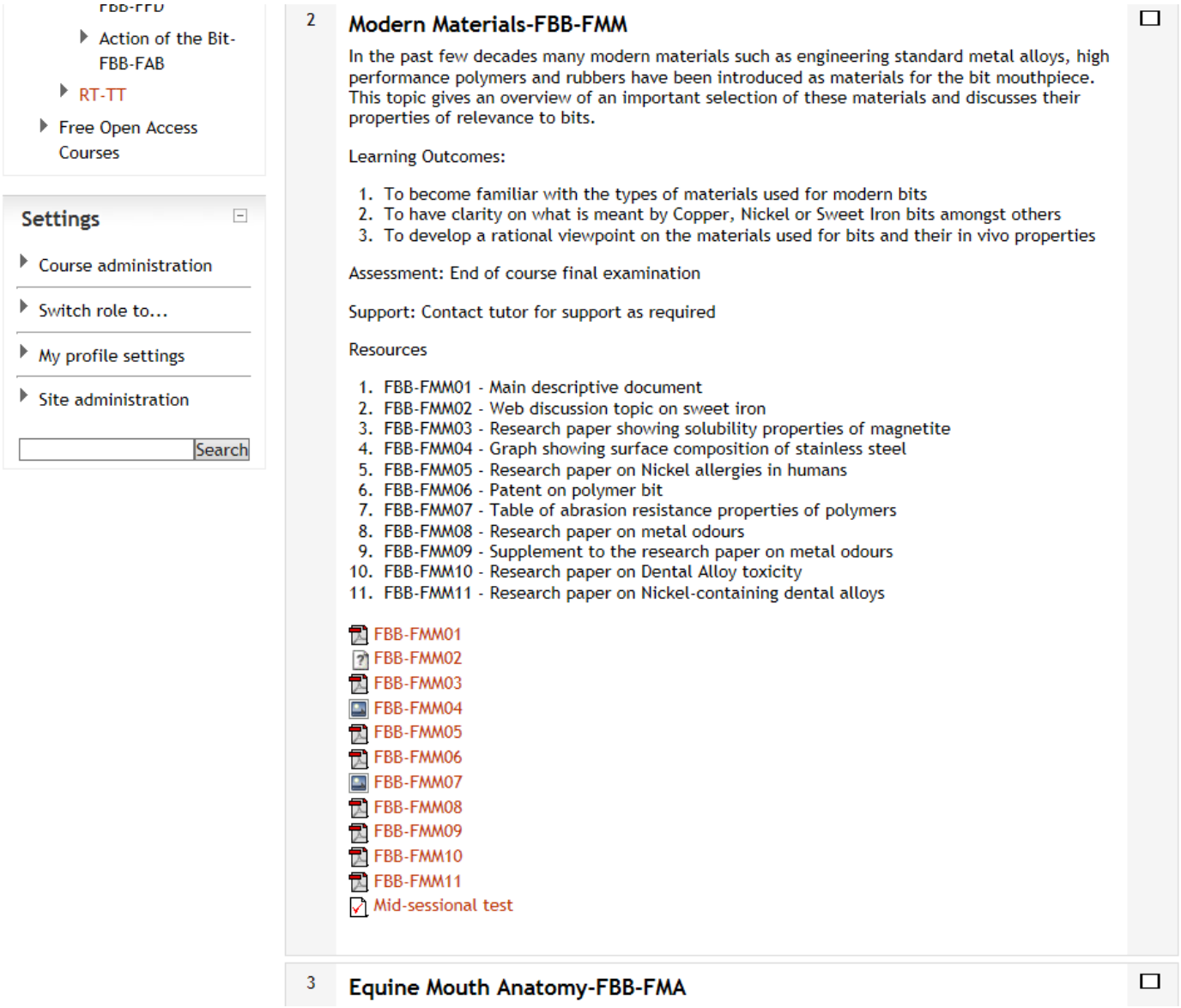
FBB-FOUNDATION-TASTER

Our first extract is from Topic 2, “Modern Materials”



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2 **Modern Materials-FBB-FMM**

In the past few decades many modern materials such as engineering standard metal alloys, high performance polymers and rubbers have been introduced as materials for the bit mouthpiece. This topic gives an overview of an important selection of these materials and discusses their properties of relevance to bits.

Learning Outcomes:

1. To become familiar with the types of materials used for modern bits
2. To have clarity on what is meant by Copper, Nickel or Sweet Iron bits amongst others
3. To develop a rational viewpoint on the materials used for bits and their in vivo properties

Assessment: End of course final examination

Support: Contact tutor for support as required

Resources

1. FBB-FMM01 - Main descriptive document
2. FBB-FMM02 - Web discussion topic on sweet iron
3. FBB-FMM03 - Research paper showing solubility properties of magnetite
4. FBB-FMM04 - Graph showing surface composition of stainless steel
5. FBB-FMM05 - Research paper on Nickel allergies in humans
6. FBB-FMM06 - Patent on polymer bit
7. FBB-FMM07 - Table of abrasion resistance properties of polymers
8. FBB-FMM08 - Research paper on metal odours
9. FBB-FMM09 - Supplement to the research paper on metal odours
10. FBB-FMM10 - Research paper on Dental Alloy toxicity
11. FBB-FMM11 - Research paper on Nickel-containing dental alloys

FBB-FMM01
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Mid-sessional test

3 **Equine Mouth Anatomy-FBB-FMA**

The list of resources includes images and research papers to support the self-learning method. While we often use peer-reviewed research papers to provide evidence of the validity of the ideas presented in the course it is not required that you can discuss the details of the science they contain. Much can be learned just by reading the conclusions or abstracts, or perhaps by looking at tables or graphs of main results and this is all we ask at this stage.

This is an extract from the descriptive document FBB-FMM01. These documents are your main source of information. Each one contains "Tasks" that require you to do some independent thinking or researching before the ideas are explained later in the document.

It is known that simply trying to answer a question – even when you may not have learnt the subject in depth – is one of the most effective ways that 'deep learning' (things you can never forget about a topic) is achieved. In fact, just reading about a subject and then simply trying to remember what you've read turns out to be one of the worst ways to learn!

Non-Metal Materials

Task: *Open the files **FBB-FMM06.pdf** and **FBB-FMM07.pdf** to see how new bits can be produced using high-tech polymers. If the aim is to produce a soft and strong yet yielding material with high abrasion resistance what commercial product might appear most suitable?*

Two major types of non-metallic materials are notable for use as horse bit mouthpieces, polymers and rubbers. The properties to note of these materials are their softness and low thermal conductivities. In terms of rubbers, Vulcanite is relatively hard and is a type of natural rubber where sulphur has been used to harden it to a greater or lesser extent.

Polymer bits may be fabricated from plastics suitable for molding. One notable example is in the case of polyurethane elastomers where a grade of polyurethane elastomer having a high abrasion resistance would be particularly suitable for use as horse bit mouthpiece material. This idea was part of the description of a patented bit described in **FBB-FMM06.pdf**. The article is in German but the abstract (page 1) mentions the possible use of "Polyurethan-Elastomeren".

Polyurethanes in general are widely used for products such as the soles of sports shoes, cushioning material and even heart valves. This latter application is relevant to the next section. It implies that good biocompatibility is present.

Modern Materials – *In vivo* properties

Task: *Look over the scientific paper **FBB-FMM08** and its supplement **FBB-FMM09** that describes the odour of metals and why it happens. What could be the evolutionary reason for the ability of humans to detect the smell of iron? Is aluminium likely to produce a smell?*

The term *in-vivo* (within the living animal) is apt to the extent that the equine mouth is capable of transferring material extracted from the bit mouthpiece into the body of the horse either by ingestion through the digestive tract or by direct absorption through the mouth tissues.

For this reason it is of interest to consider what is known about the bioactivity of metal ions (soluble forms of the metal atoms comprising the mouthpiece). Even in polymer bits there may be the potential for the extraction of small amounts of metal ions remaining from the catalysts used in the manufacture of the polymers.

As suggested above, stainless steel is one example where it is almost irrelevant what metals comprise the alloy from the point of view of biocompatibility. The chromium oxide coating effectively traps in the metals that would otherwise be available for ingestion or absorption.

For the copper alloy bits this is in general not the case. Copper, Zinc, Manganese, Nickel and Tin may all be available in some quantities when using the bit.

The bioavailability of iron and copper has in the past been relied on to provide a metal ion conferring the property of taste to the mouthpiece. That such metal ions can produce taste is undisputed and it is found that the taste probably comes from a chemical reaction of the metal in contact with skin tissue under slightly acidic conditions. Although saliva is normally neutral, there can be conditions which make it slightly acidic and the possibility therefore exists that odours can be experienced by the horse as tastes when using a metal bit where iron, copper or zinc are present. Aluminium by contrast does not become bioavailable in the same way.

Odour and taste are related in the perception of what is often simply considered 'taste' (http://www.brainfacts.org/sensing-thinking-behaving/senses-and-perception/articles/2012/taste-and-smell/ : Accessed 10th April 2015). The reaction of certain metal ions with sweat and possibly saliva releases volatile organic compounds (VOCs) that can produce odours. The two papers suggested as source reading give more details.

Task: *View the research papers **FBB-FMM10** and **FBB-FMM11** on dental implant metals and use the information given earlier to determine what if any possible problems with toxicity (in humans at least) might be present with modern metals used for mouthpieces.*

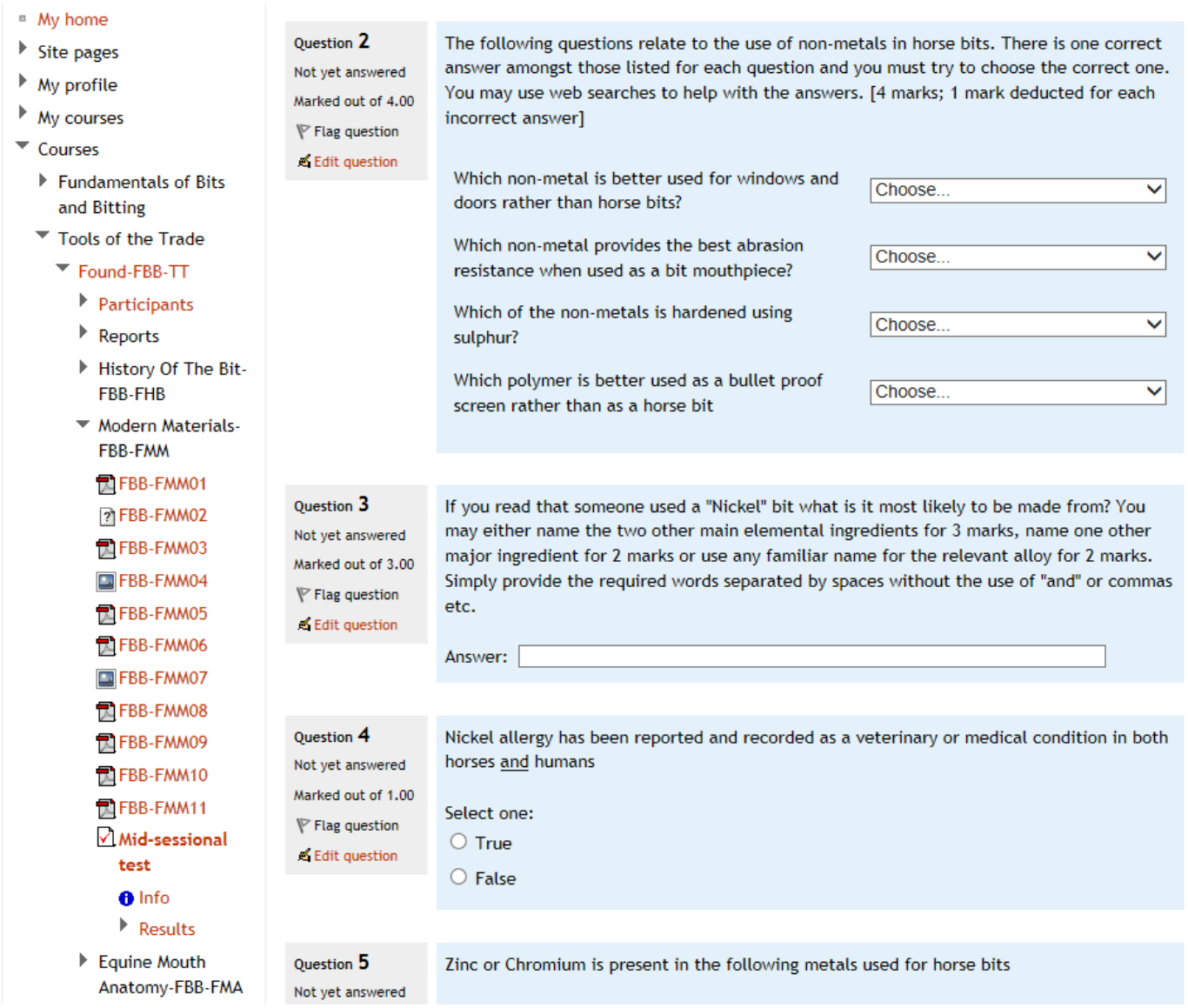
Toxicity is a very complex but often highly charged and misrepresented subject. To understand it requires one to consider how acute the toxicity might be, what sensitivity the horse has to any possible toxins and how bioavailable they are.

For this reason it is extremely useful to take advice from the very many studies undertaken to determine the toxicity or allergenic properties of dental alloys. These alloys can contain all of the mouthpiece metals in varying amounts and they are obviously exposed to saliva and mouth tissue continuously. The bit by contrast is unlikely to be in the horse's mouth for more than 2 – 3 hours a day at most on average.

Rather than discussing in detail the results in the two scientific papers given as suggested reading we can summarise with some general observations:

1. The quantities of metal ions released from a bit mouthpiece are likely to be small relative to the amounts ingested through feeding. There is some discussion over the amount of iron ingested by the horse and a possible consequent inhibition of the required uptake of copper, zinc and manganese. The subject is complex.
2. There has been no published veterinary-based evidence for metal allergies in horses nor any published work showing a toxicity to metals derived from using a bit in the horse.
3. By contrast metal allergies in humans is a recognised condition where it has a known biochemical mechanism.
4. Metals used as dental implants are found to give no measurable evidence of toxicity or allergy in humans. This surprising result even applies to those human subjects that are known to be sensitive to Nickel by skin reactions.
5. It is wise to be cautious when transferring the scientific evidence from the human subject onto the equine subject.
6. The studies on dental implants cover only those metals already considered to be safe for human use. These are the metals found in most metal-based horse bit mouthpieces.

This is part of the mid-sessional test for the Modern Materials topic. Questions such as these will appear both in the coursework and in the final examination and your final grade will depend on your performance in all these assessments.



Of course you will always have access to your notes, the coursework material and other sources of information as you complete the tests. In this sense the tests are a type of “open book” examination. There will be time limits to complete the assessments but there is no reason why you should be unable to answer those questions that simply require you to recall the facts and principles.

We will have two levels of test throughout the course and final examination.

In the first level students will be able to achieve a pass mark for the course by successfully completing tests comprising questions such as those shown above. In the second level the questions will demand a degree of insight and students able to successfully complete these tests will have the opportunity to pass the course “With Distinction”.

This is an extract from Topic 4, Force Distribution.

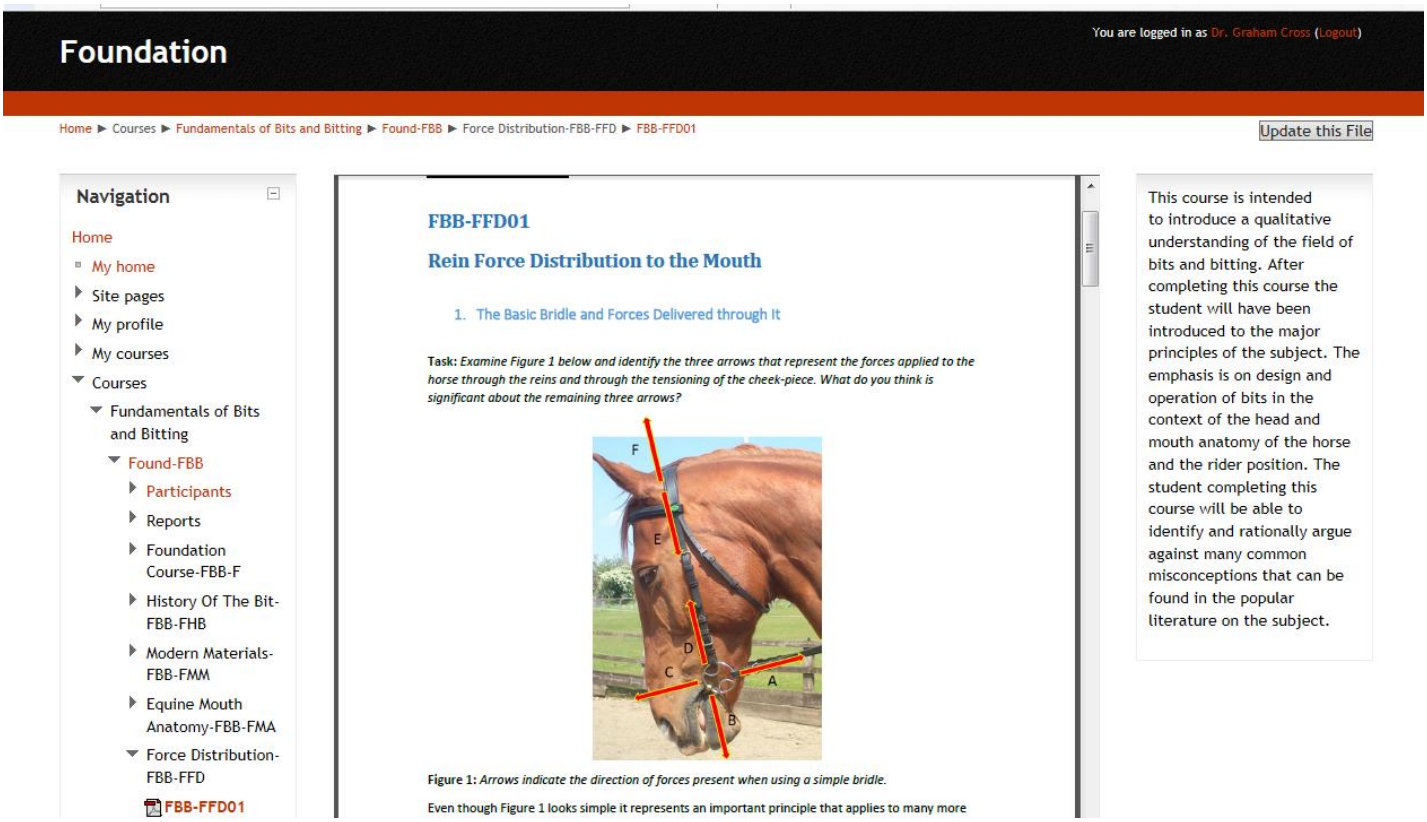
4

Force Distribution-FBB-FFD

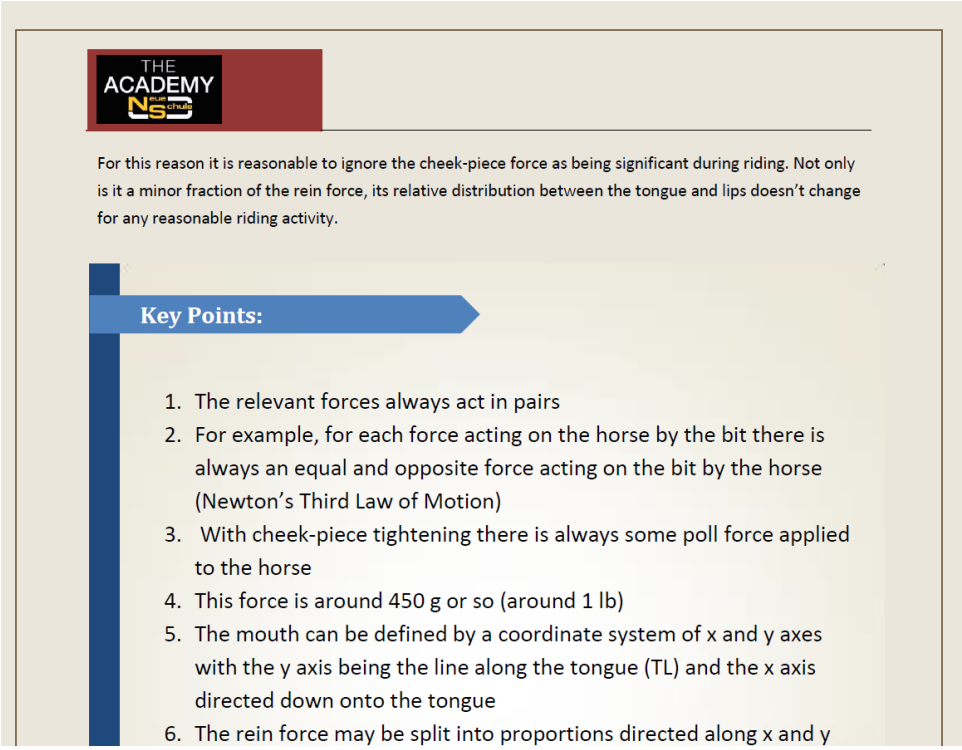
When rein tension is applied the bit is drawn towards the rider and the force is distributed over the equine lips and tongue to varying degrees. This topic introduces a new way of looking at the horse, the bit and the bridle - identifying lines of action of forces, in addition to seeing simply the lines of the bridlework and the horse, and considering the direction and effect of the distributed forces.

Learning Outcomes:

1. An understanding of how to identify the direction and presence of forces applied through the reins and bridle-work.
2. An appreciation that all applied forces are balanced by reaction forces produced by the horse and that poll pressure is an inevitable consequence of fitting a bridle.
3. To understand the splitting up of the applied forces into those that act directly down on the tongue and those that act along the tongue, or into the corners of the mouth.
4. An understanding of how the rein forces transfer between the tongue and corners of the mouth depending on the head position during riding.
5. To discover that rein tension during riding is not constant even with the best of hands!



This rather technical topic is carefully constructed and delivered with the understanding that non-scientists and those without technical backgrounds are amongst the majority of students. Remember that there is tutor support available for all topics.



For this reason it is reasonable to ignore the cheek-piece force as being significant during riding. Not only is it a minor fraction of the rein force, its relative distribution between the tongue and lips doesn't change for any reasonable riding activity.

Key Points:

1. The relevant forces always act in pairs
2. For example, for each force acting on the horse by the bit there is always an equal and opposite force acting on the bit by the horse (Newton's Third Law of Motion)
3. With cheek-piece tightening there is always some poll force applied to the horse
4. This force is around 450 g or so (around 1 lb)
5. The mouth can be defined by a coordinate system of x and y axes with the y axis being the line along the tongue (TL) and the x axis directed down onto the tongue
6. The rein force may be split into proportions directed along x and y

Finally, all topics end with a "Key Points" box. You should ensure that you are familiar with these points to successfully complete the course.

Final Word

We hope that this preview has inspired you to enrol on the Foundation course and that you feel that it is something that you will find interesting and beneficial. We welcome all of our enrolling students and look forward to working with you on this project.

Many of you will be able to improve our performance perhaps by correcting things we've got wrong or providing ideas for additional topics to go into future courses. We welcome these contributions as you study the course where they might even form topics for forum discussion suitable for the whole cohort. In this way you are contributing to a more structured and informed approach to the learning of the often unfathomable subject of bitting.

Dr. Graham Cross (Director of Studies)