THE UNIVERSITY OF MELBOURNE

Melbourne Veterinary School

IVP

Module 2 – Care and Welfare of domestic animals

Introduction to nutrition

Part 1: Feed function, constituents and sources

Professor Simon Bailey
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(with acknowledgement to Dr. Ian Bland)

VETS30030 / VETS90122

Intended Learning Outcomes

- Identify different feed types, sources and nutritional ‘qualities’

  Always:

  Sunlight → herbage → animals and animal products

- Compare and contrast nutritional requirements and methods of feed utilisation of herbivores, carnivores, & omnivores; in order to assess the appropriateness of different diets and feedstuffs for different groups of animals.

Why is nutrition important to the veterinary profession?

- Keeping domestic animals means feeding them differently to ‘in the wild’

- Feeding a ‘natural diet’ is not easy
  - Price; convenience; safety (cats and dogs)
  - Feeding for growth (production animals)
  - Feeding for performance (horses; racing greyhounds)

- Many conditions linked to diet or feeding practices:
  - E.g. horses: tooth problems, colic, obesity, laminitis, equine asthma, hyperlipidaemia, ‘tying up’,

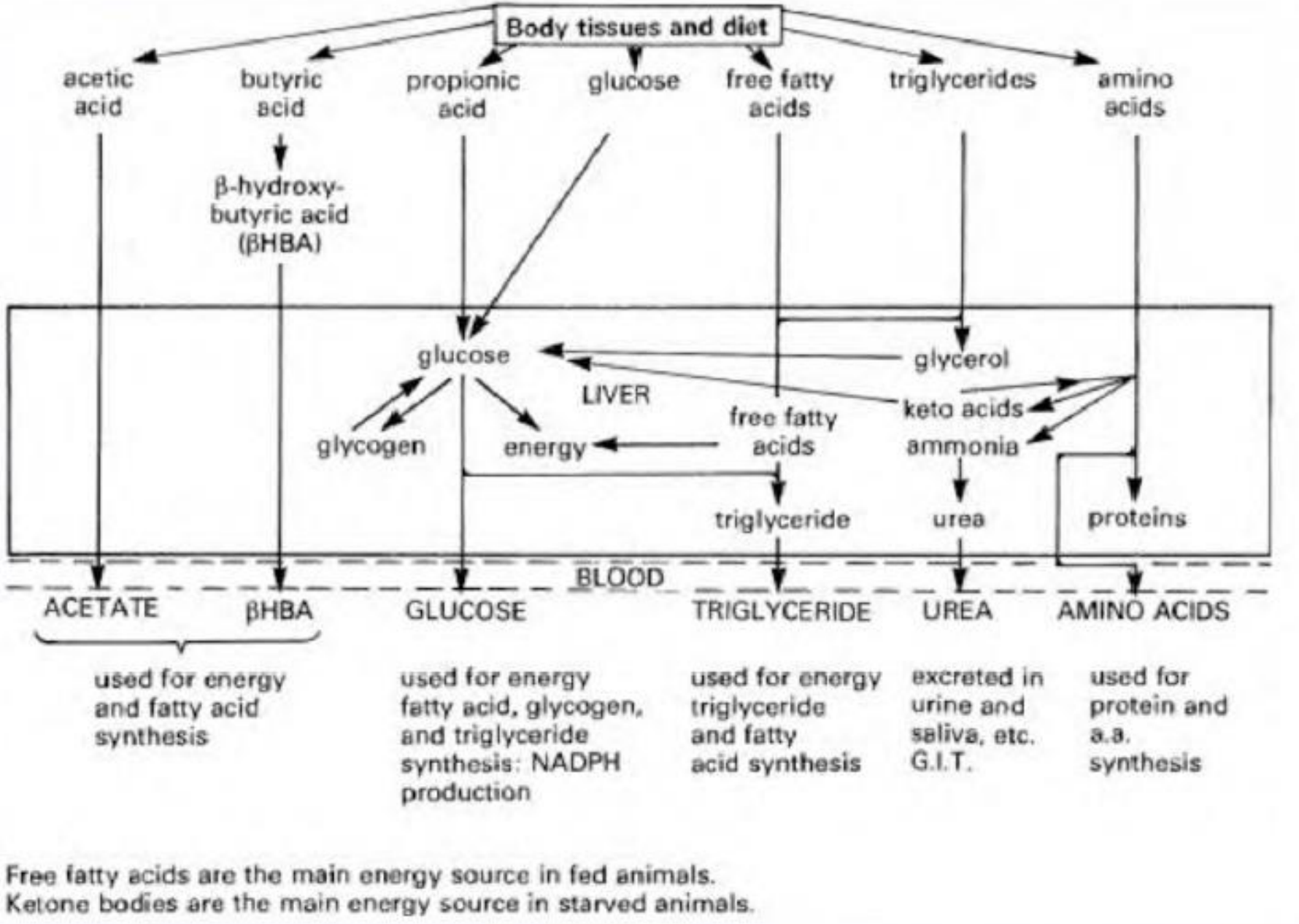
Why is it needed? How is it used?

- Nutrition is fundamental to animal well-being.
- An understanding of animal nutrition is vital to maintaining animal health and correcting nutritional diseases.
- In a world of ever-increasing competition for resources, as we use animals for food, fibre and work, nutrients must be utilised efficiently if we are to live sustainably and farms are to remain economically viable.

Three major functions of foods

- Energy
  - Provided by carbohydrates, fats, fibre (herbivores especially), [proteins]
- Tissue building blocks
  - Provided by proteins and fats
- Essential components
  - E.g. enzymes, hormones, vitamins

Processing and use of major body metabolites in ruminants



Free fatty acids are the main energy source in fed animals.
Ketone bodies are the main energy source in starved animals.

Sources of food components

Sources of food components

Carbohydrates
- cereals & vegetables

from
- concentrates
- forages
- (any CHOs from animal tissues?)

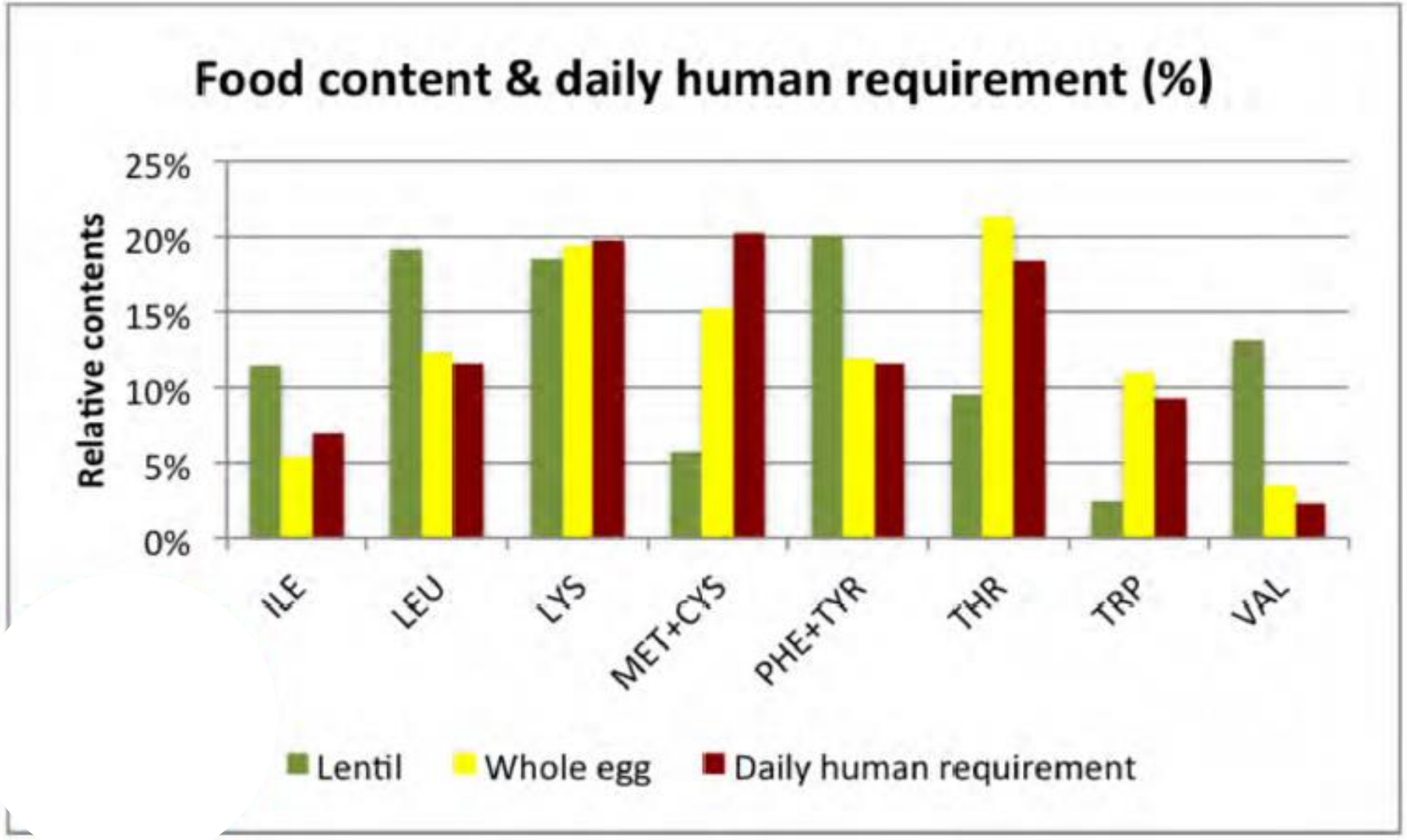
Protein
- plants (concentrates & forages)
- meat
- milk/eggs

Fibre
- plants (forages)
- indigestible to carnivores
- BUT major herbivore food source!

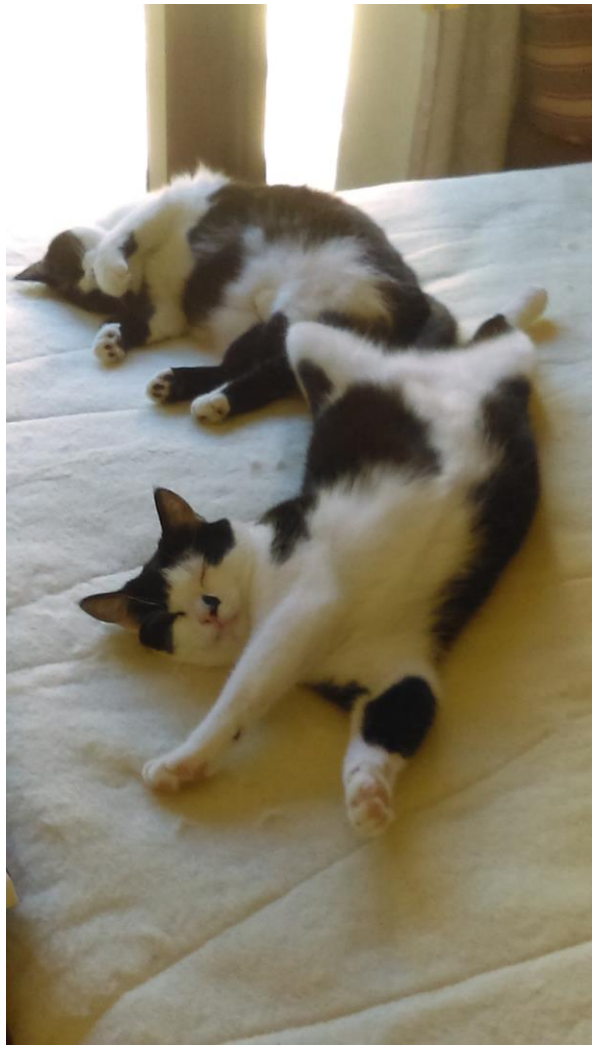
Micronutrients
- may come from all feed types
- (is soil a feed type?)

Fats & oils
- meats
- milk/eggs
- plants (often plant concentrates e.g. seeds & fruits)

What's special about foods *from* animals?



Some species have more essential nutrients than others



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Part 2: Pasture, forages and concentrates

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Nutritionally, what do we want from plants and pastures?

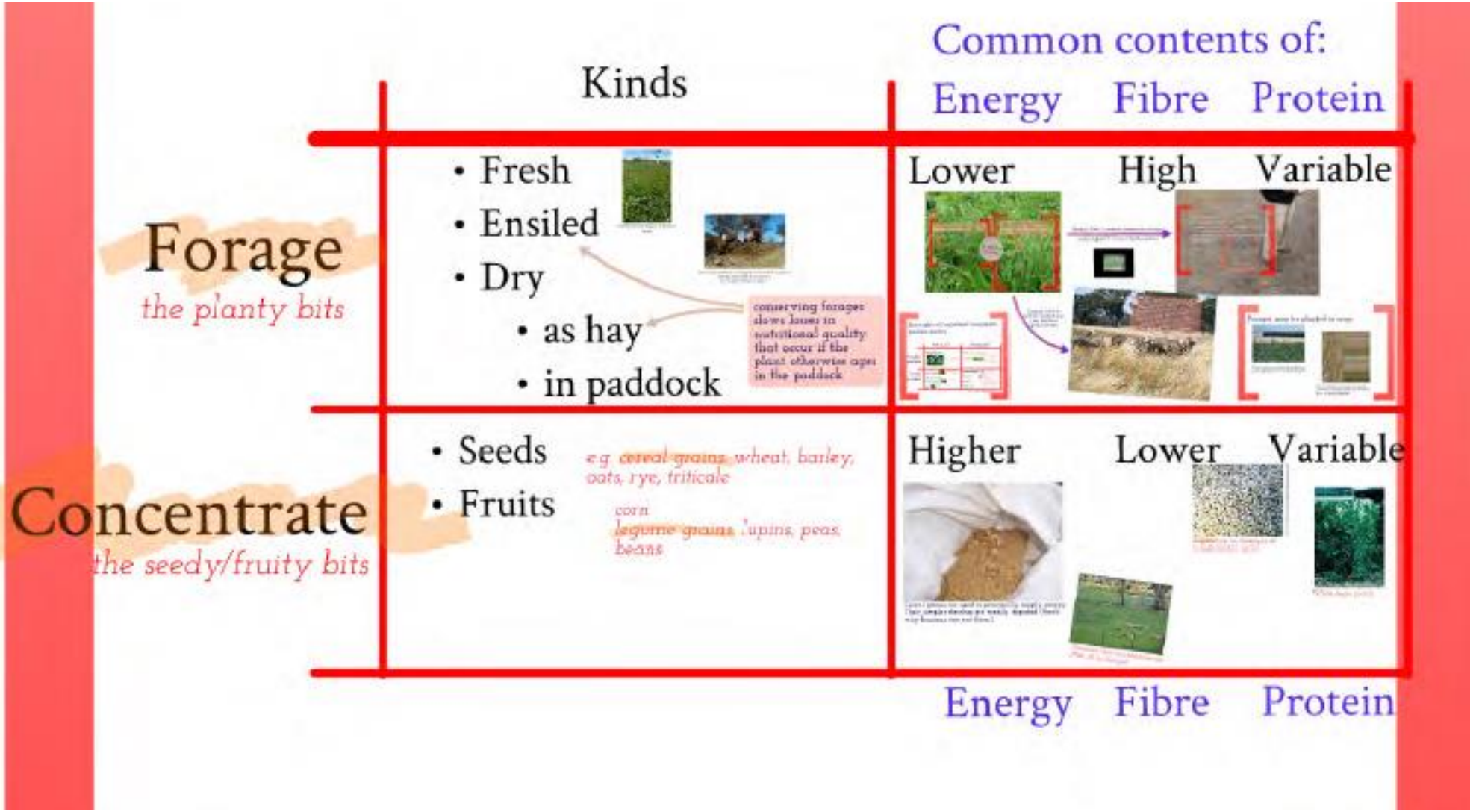
- Supply of:
  - energy,
  - fibre,
  - protein

- This can be achieved with sown pastures or natural pastures and plants

An ideal pasture is:

- Nutritious
- Meets nutritional requirements year round
- Persists under grazing and out-competes weeds
- Maintains ground cover (prevents erosion)
- Doesn’t cause health problems

Comparing plant types: forages and concentrates



Energy, fibre and protein in forages

- High in **fibre:**
  - Plants' structure derived from 'structural carbohydrates': cellulose, hemicellulose, pectin, lignin
  - Indigestible by the mammalian gastro-intestinal enzymes
  - BUT microbes can digest C, HC and P to obtain energy!
  - Herbivores use microbial function to digest plant fibre
  - (very few organisms can digest lignin)

- Lower in energy
- Variable protein

Both forages and concentrates contain: energy, fibre and protein

Seasonal variation in forage nutrient quality

Autumn:
Quality low before rainfall starts to increase

Winter:
high quality but low quantity

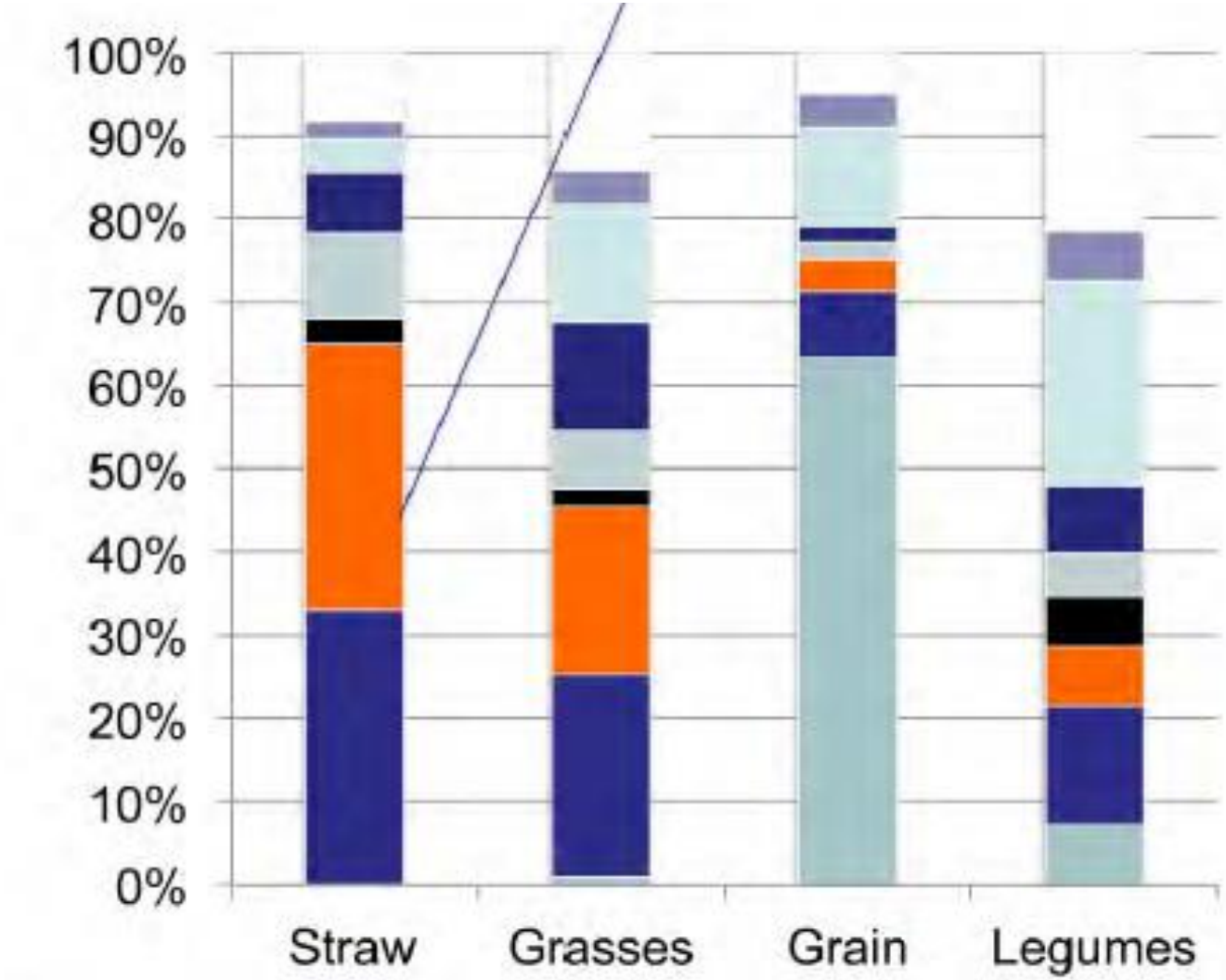
Spring:
High quality, abundant quantity

Summer:
Quality and quantity declines

Energy, fibre and protein in concentrates

- Higher in energy
  - E.g. starch – can be digested by mammalian GIT tract enzymes
- Lower in fibre
  - Higher in peas, beans; lower in grains
- Variable protein
  - High in peas, beans
  - Low in grains

Typical plant feed compositions



Other
Lipids
Crude protein
Other α & ß
Lignin
Pectin (ß1)
Hemicellulose (ß1)
Cellulose (ß1)
Starch (α1-linked polysacc)

Fats
Protein
Fibre
Carbohydrates

Physiology of Domestic Animals, p. 443

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Part 3: Feed utilisation by animals

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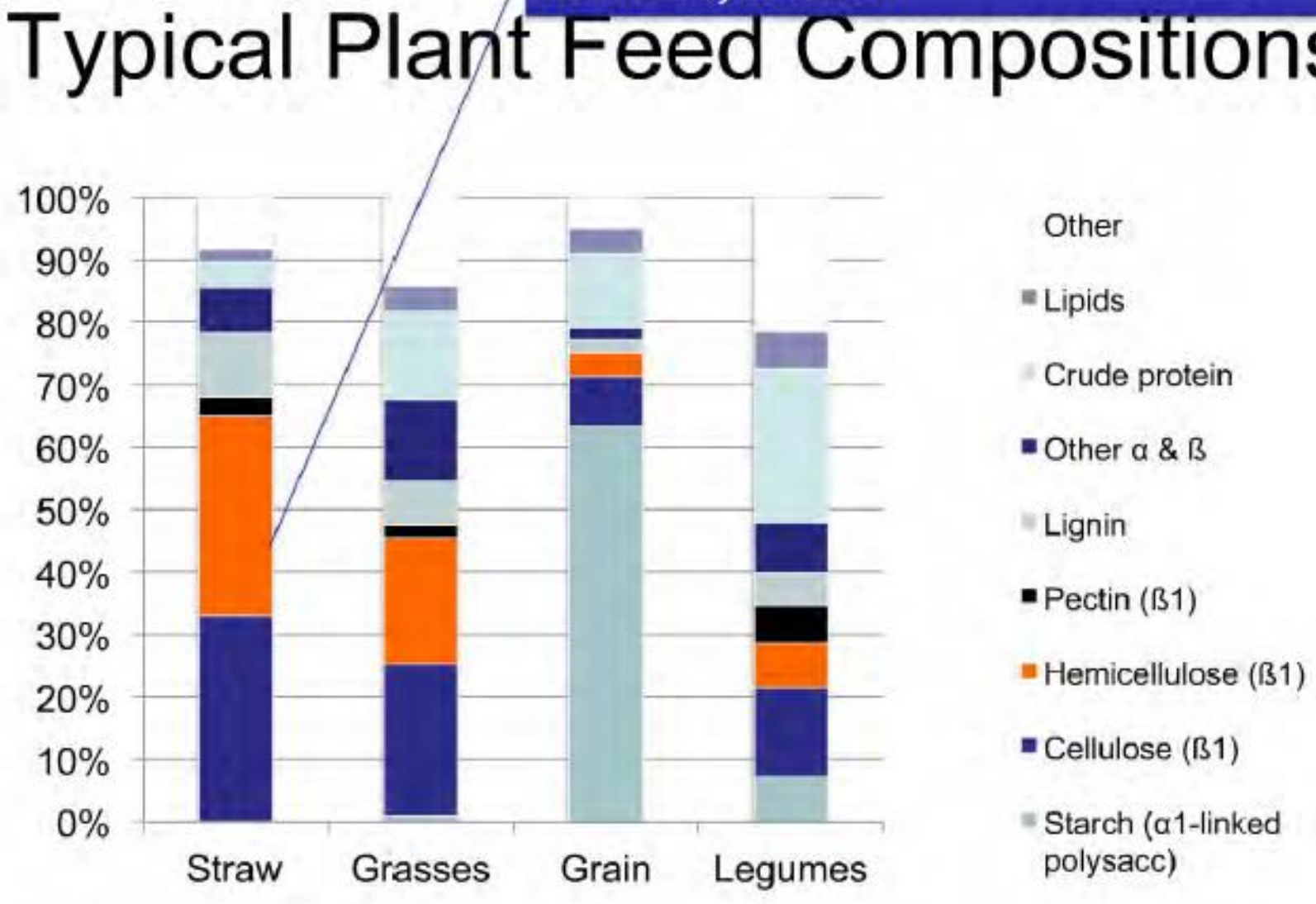
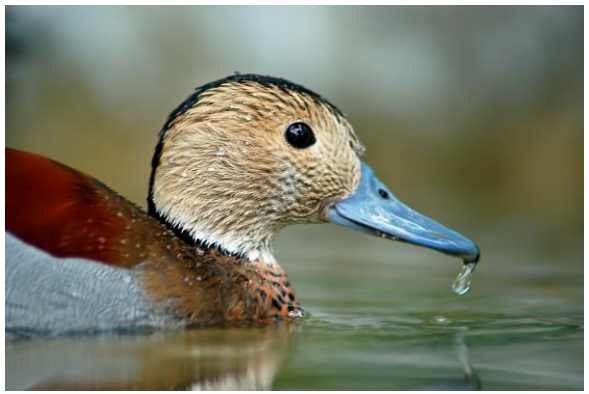
Feed utilisation by animals

•Cellulose & other structural CHOs are high in energy BUT
•Indigestible by mammals
•How can they be utilised?

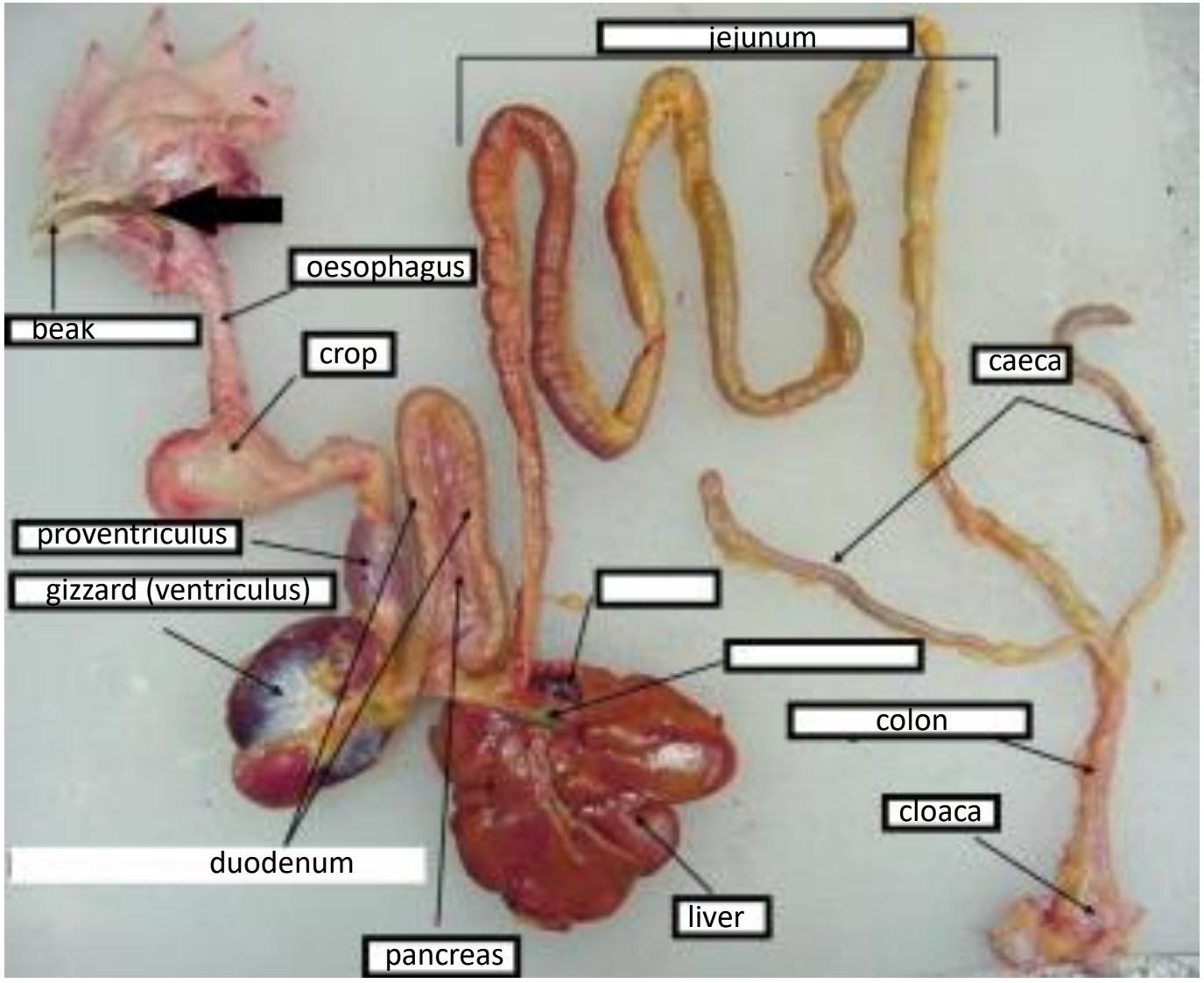


Head adaptations: mouths and beaks

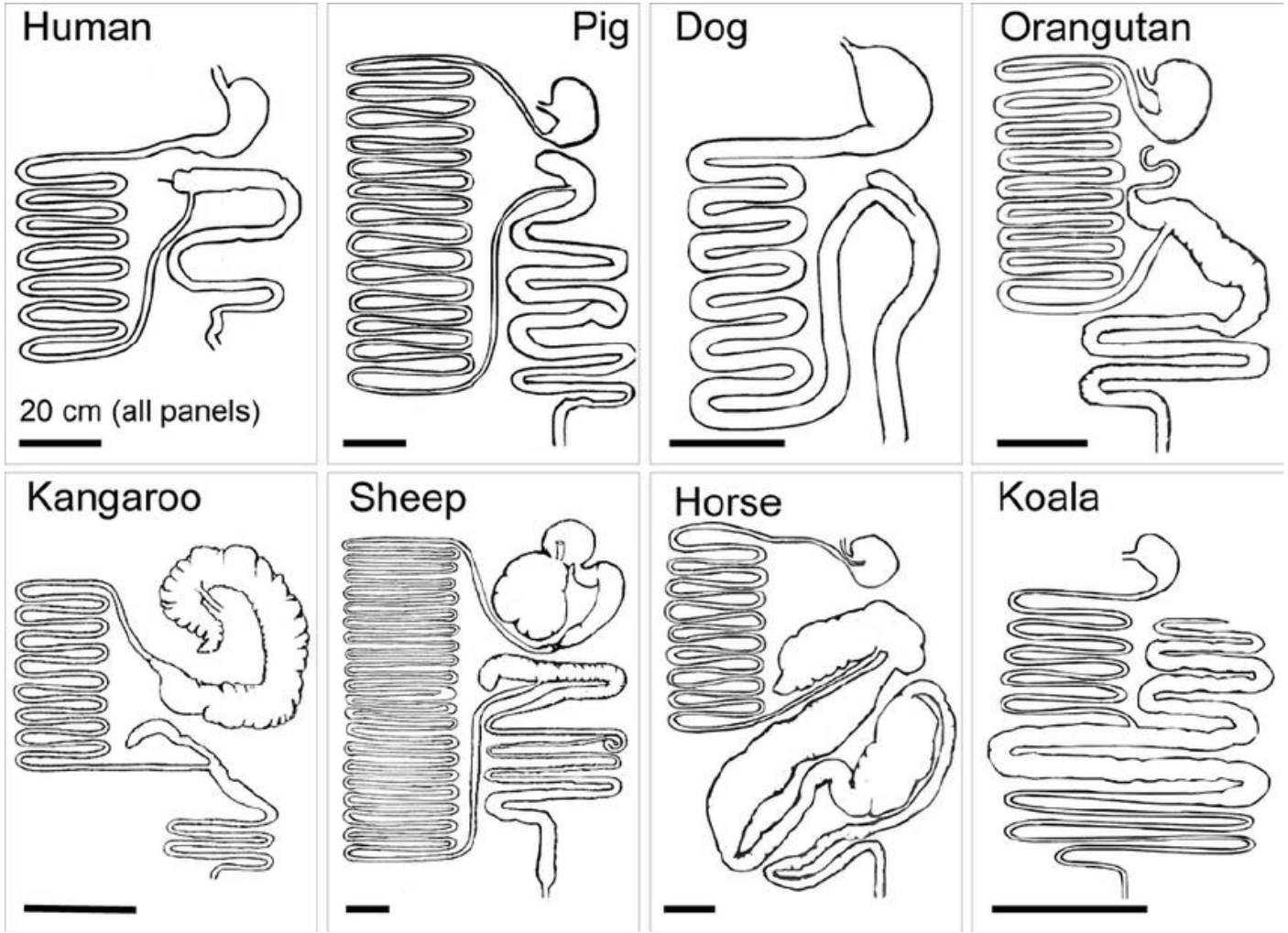


Birds

- Birds have no teeth and usually few jaw and tongue muscles (to save weight)
- Food may be stored in the crop (part of the oesophagus)
- The glandular part of the stomach is the proventriculus
- Food grinding is in the muscular gizzard (ventriculus), which may contain swallowed grit or stones

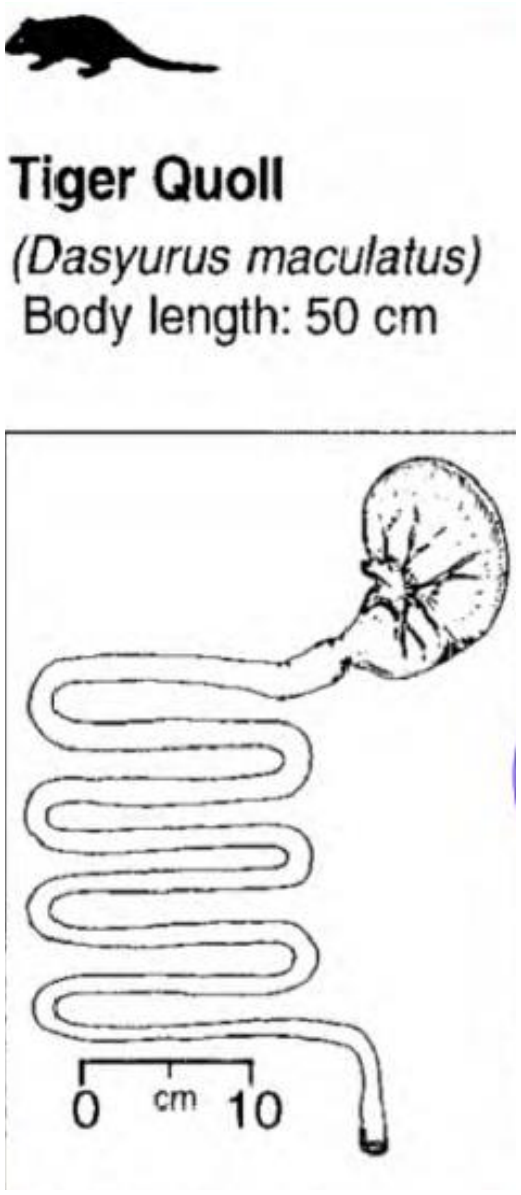


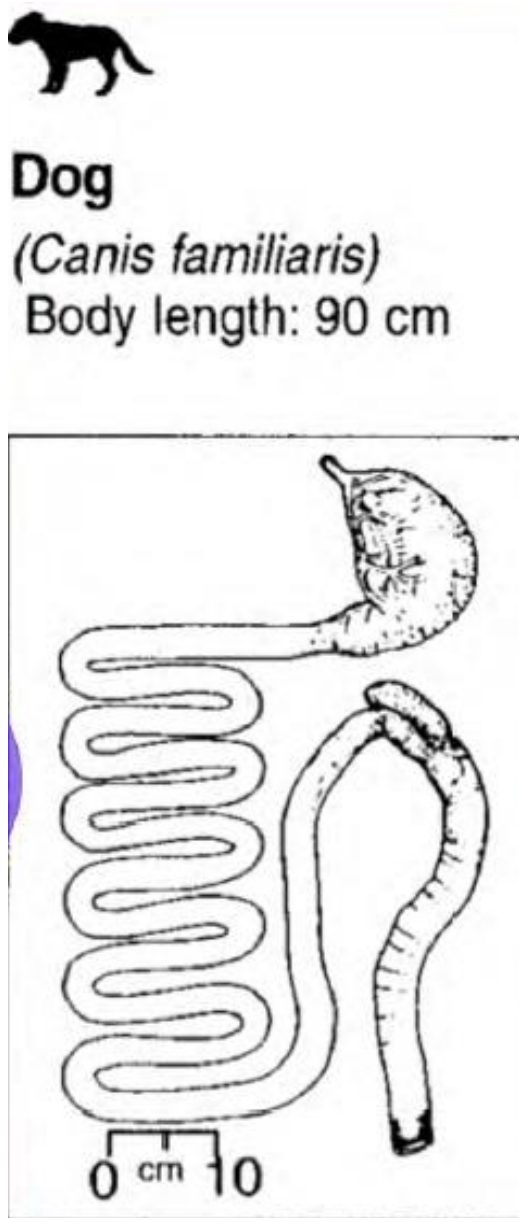
Gut complexity increases as diets become less based on animal-derived feeds



Carnivores

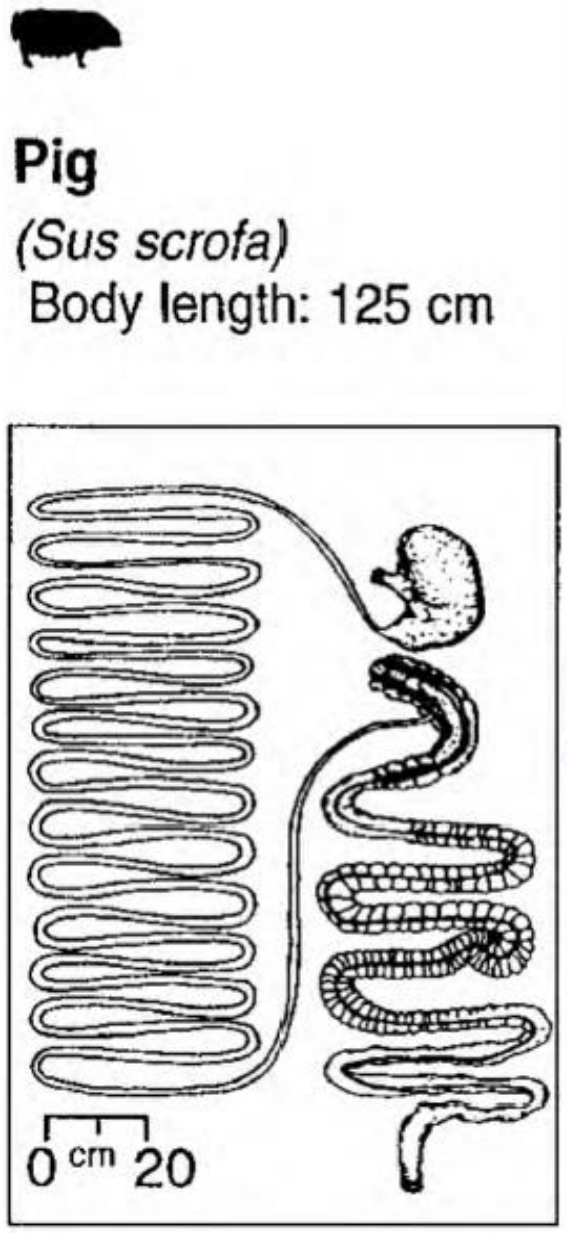
- High biological value foods are quickly and easily digested. A simple gut with small storage will do.
- Diets of animal products are high biological value foods





Omnivores

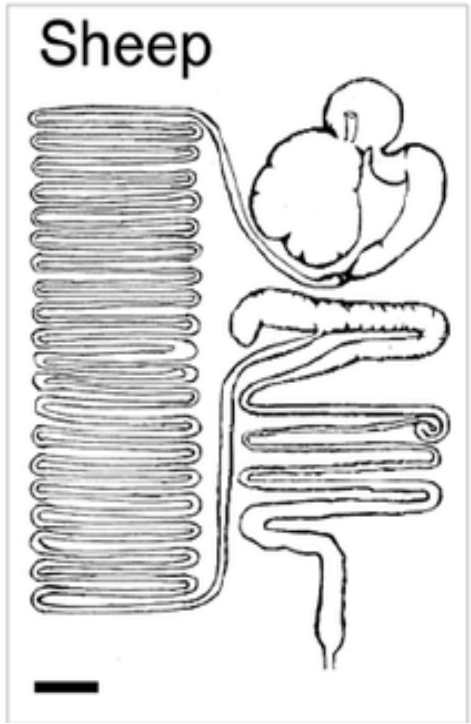
- An omnivorous animal has more space for digesting and microbial fermentation.

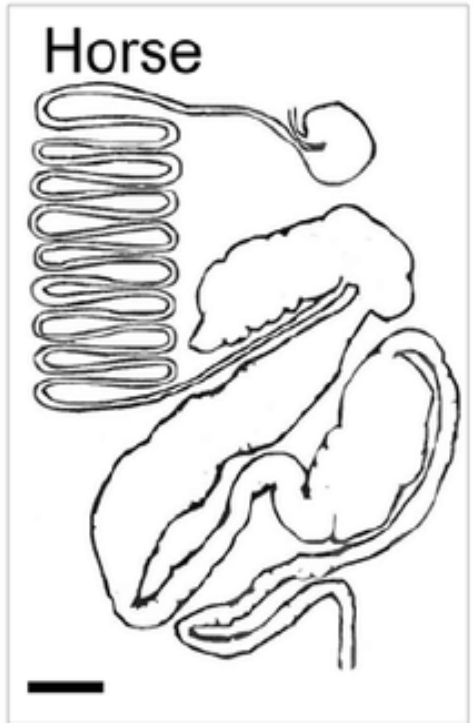


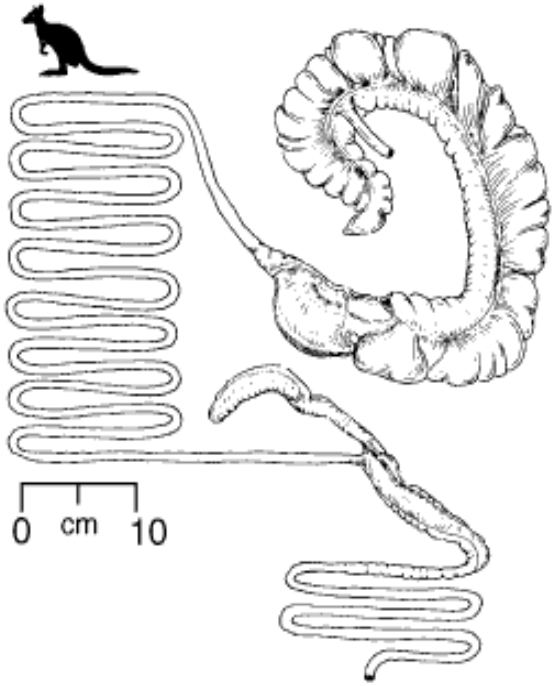
Herbivores

- Herbivores ferment cellulose and other plant structural CHOs in the fore- and/or hindgut

- Herbivores need large gut sections to hold enough low-density food while its digested and to house microbes to digest plant structural carbohydrates







Foregut fermenters

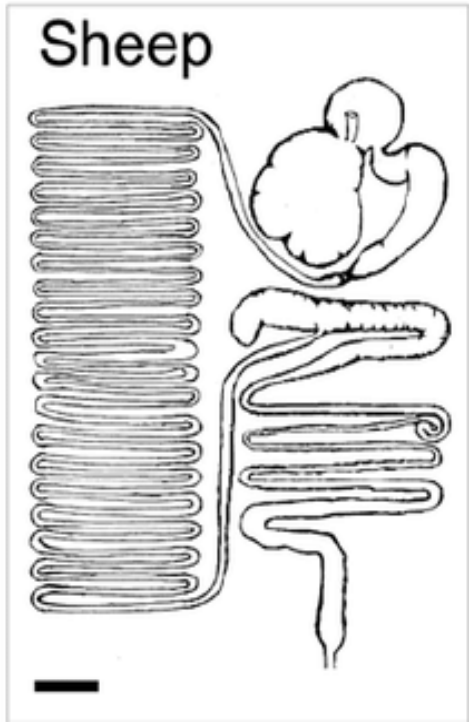
- Foregut fermenters get the benefit of microbial digestion FIRST
- This is less efficient on high quality feed
- But best at utilising low quality feed

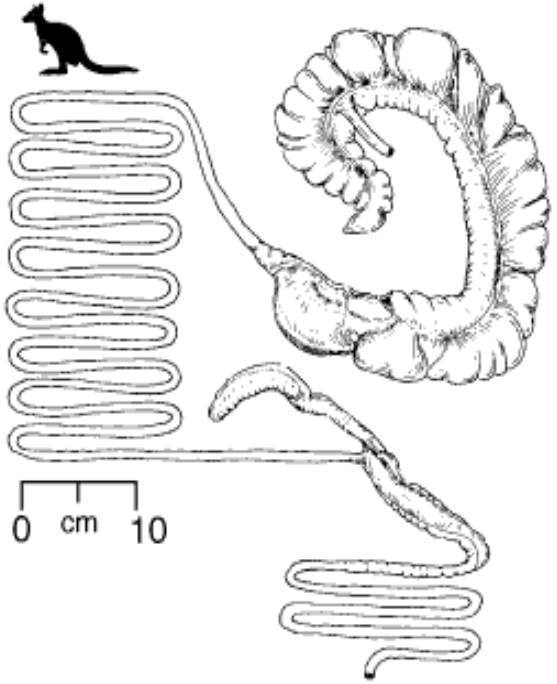
Sheep:

- Ruminant foregut fermenters

Kangaroo:

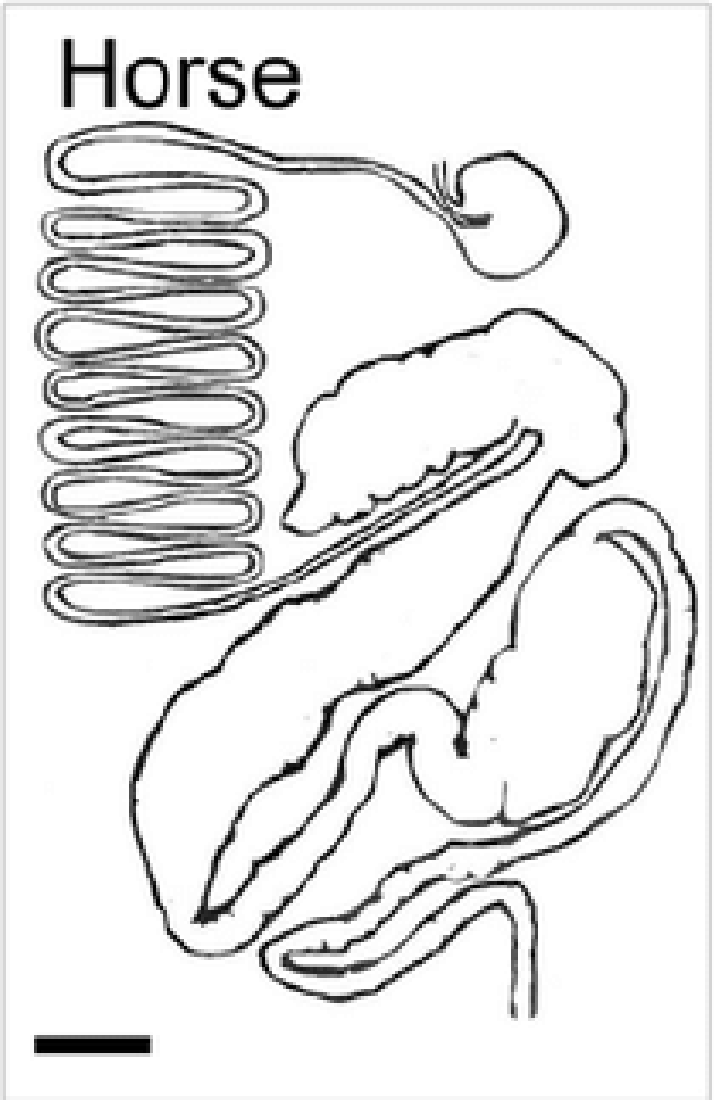
- Non-ruminant foregut fermenters



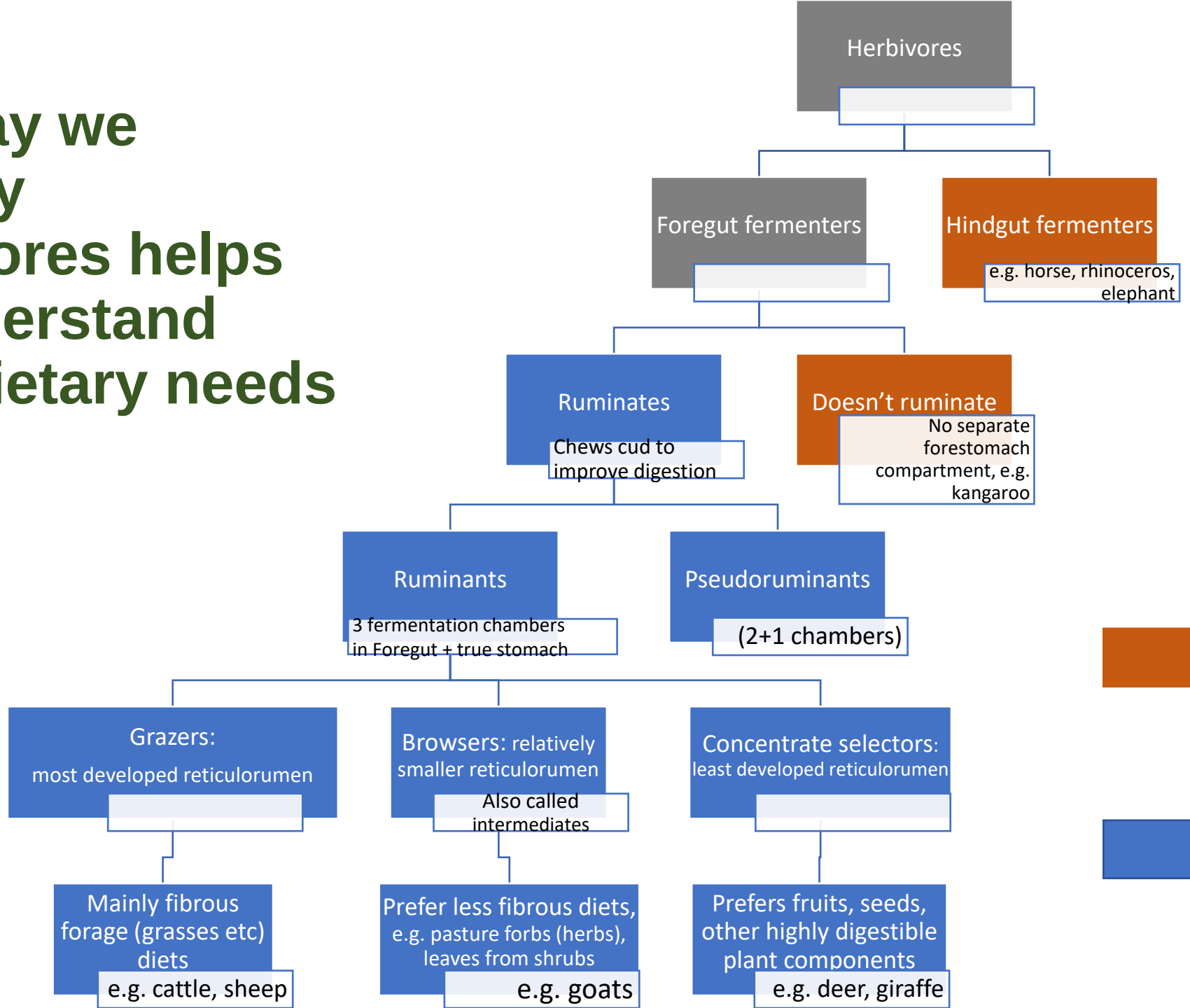


Hindgut fermenters

- Hindgut fermenters can digest better quality feed themselves in the upper gut
- Less wastage than with microbial digestion
- But they can’t utilise as many microbial products as ruminants without eating their faeces (coprophagy)
- Some do this (rabbits, guinea pigs)



The way we classify herbivores helps us understand their dietary needs



Monogastrics (along with omnivores and carnivores)

'Multigastrics'

Summary

- Different feed types, sources and nutritional ‘qualities’
- Pasture, forages and concentrates
- Compare and contrast nutritional requirements with methods of feed utilisation