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# **NUTRIENT REQUIREMENTS – COW- CALF**

# Determining Animal Nutrient Requirements

- Established through research
  - Titrated feeding studies
    - Carcass composition
  - Heat production studies
  - Animal performance
- Based upon differences in
  - Gender
  - Age
  - Weight
  - State of production
    - Gestation, lactation, weight gain

# Nutrient Requirements for Body Maintenance

- Body Maintenance: A condition in which the body is maintained without an increase or decrease in body weight, and with no production or work being done.
- Examples:
  - Body tissue repair
  - Control of body temperature
  - Energy to keep vital organs functioning
  - Water balance maintenance

# Nutrient Requirements for Growth

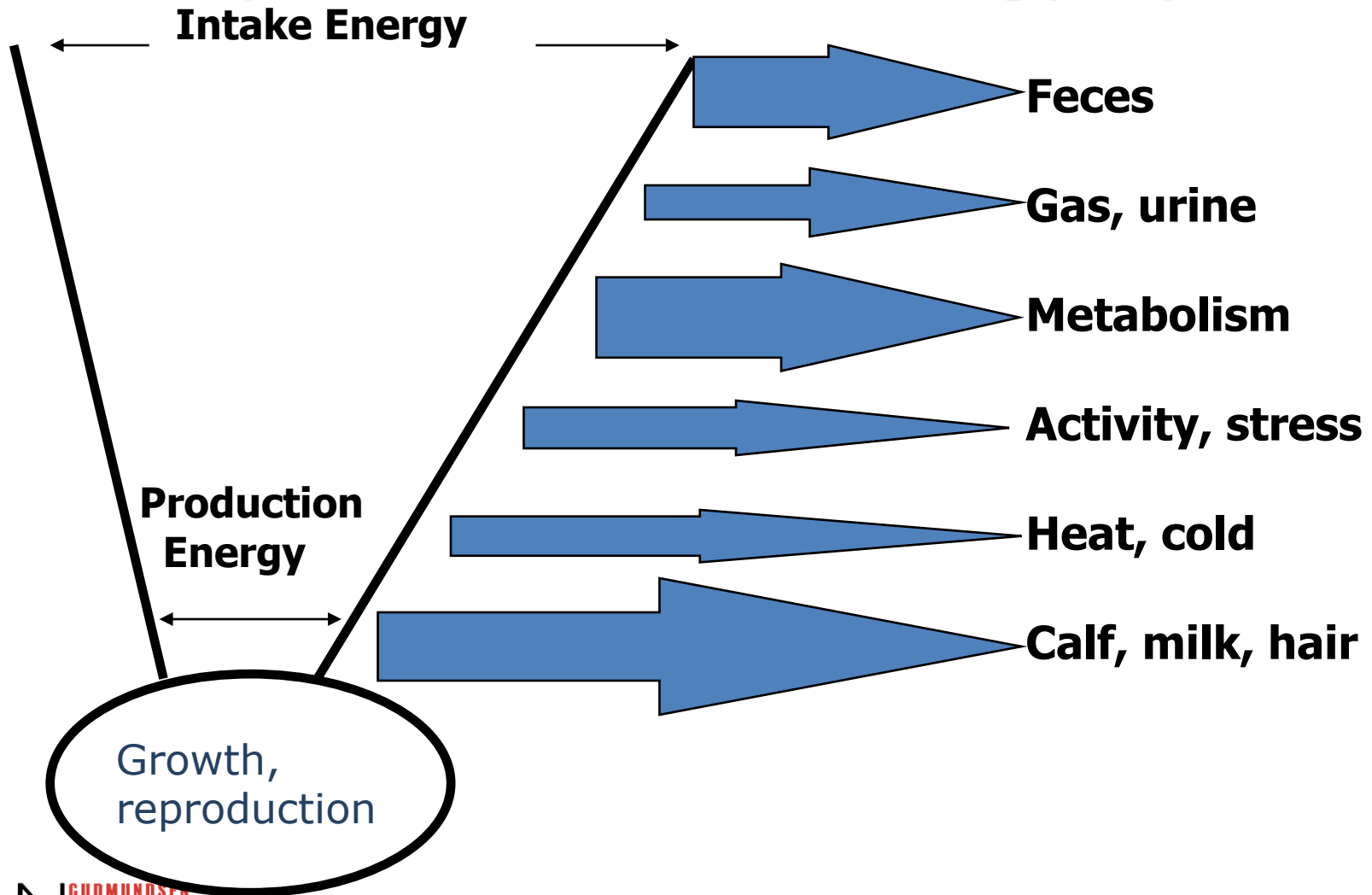
- Growth is the increase in protein over its loss in the animal body. It occurs by increases in cell numbers, cell size or both
- Growth requires energy, protein, minerals, and vitamins
- Young animals require more protein in order to build muscle and grow
  - Limiting certain amino acids
    - Lysine, methionine, etc.

# Factors affecting nutrient requirements of the cowherd

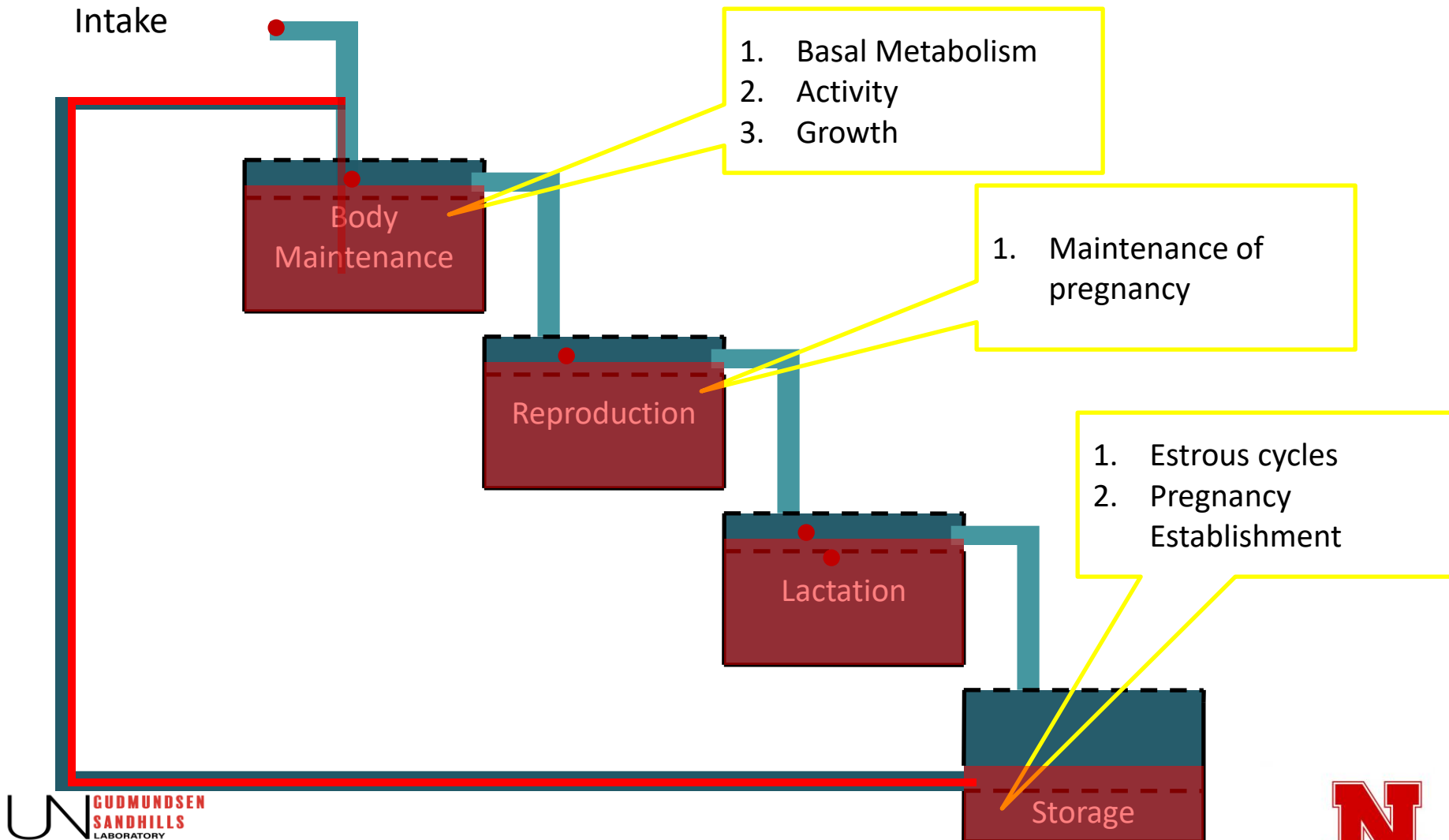


- Body Size
- Age
- Pregnancy
- Lactation
- Growth
- Activity
- Environment
- Breed

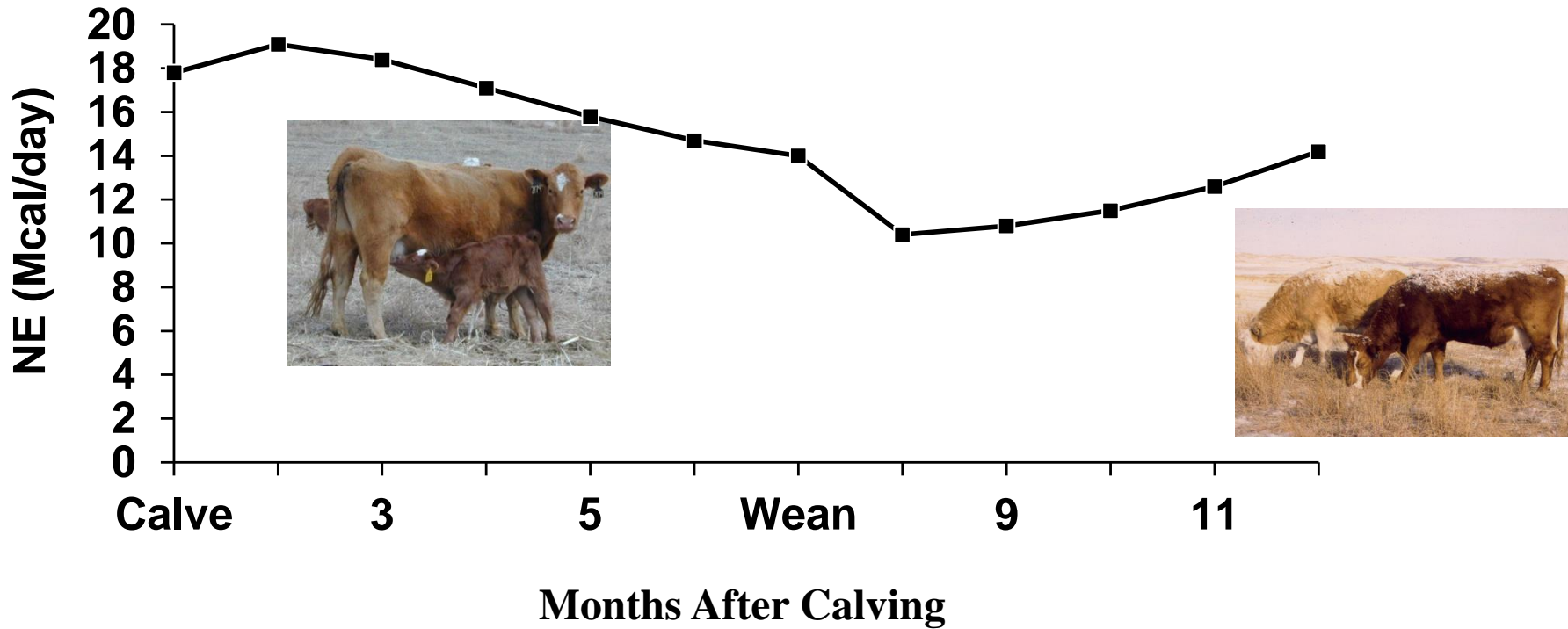
# Priority Utilization of Energy by Cattle



# Prioritization of Nutrient use by Ruminants



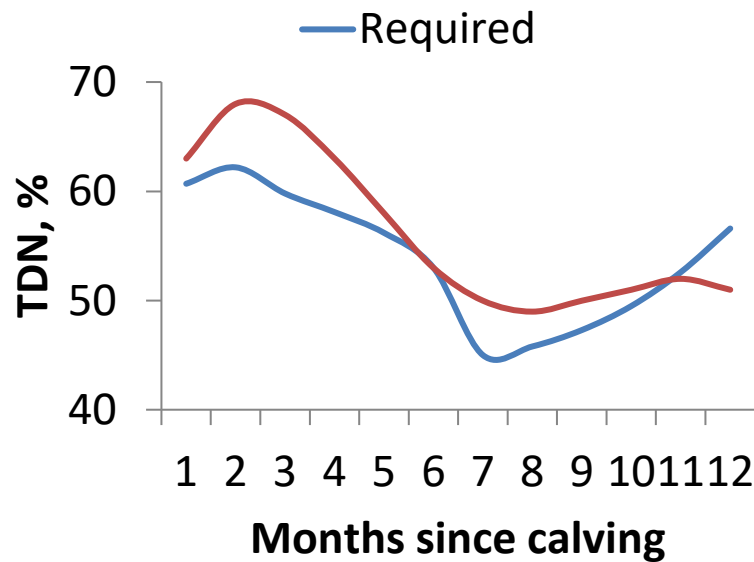
# Net Energy (NE) Requirements for a 1200 lb March Calving Cow with 23 lbs/day Peak Milk Production



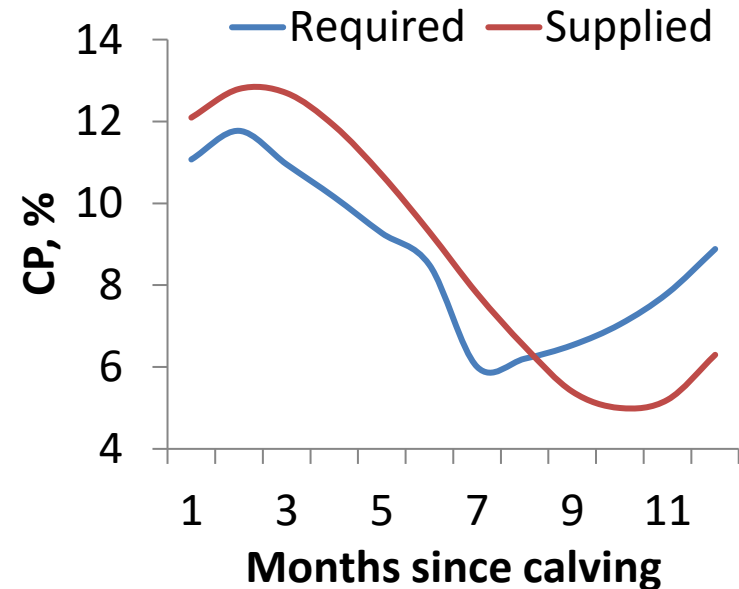


# Forage Supply and Animal Requirements in March-calving Sandhills cow

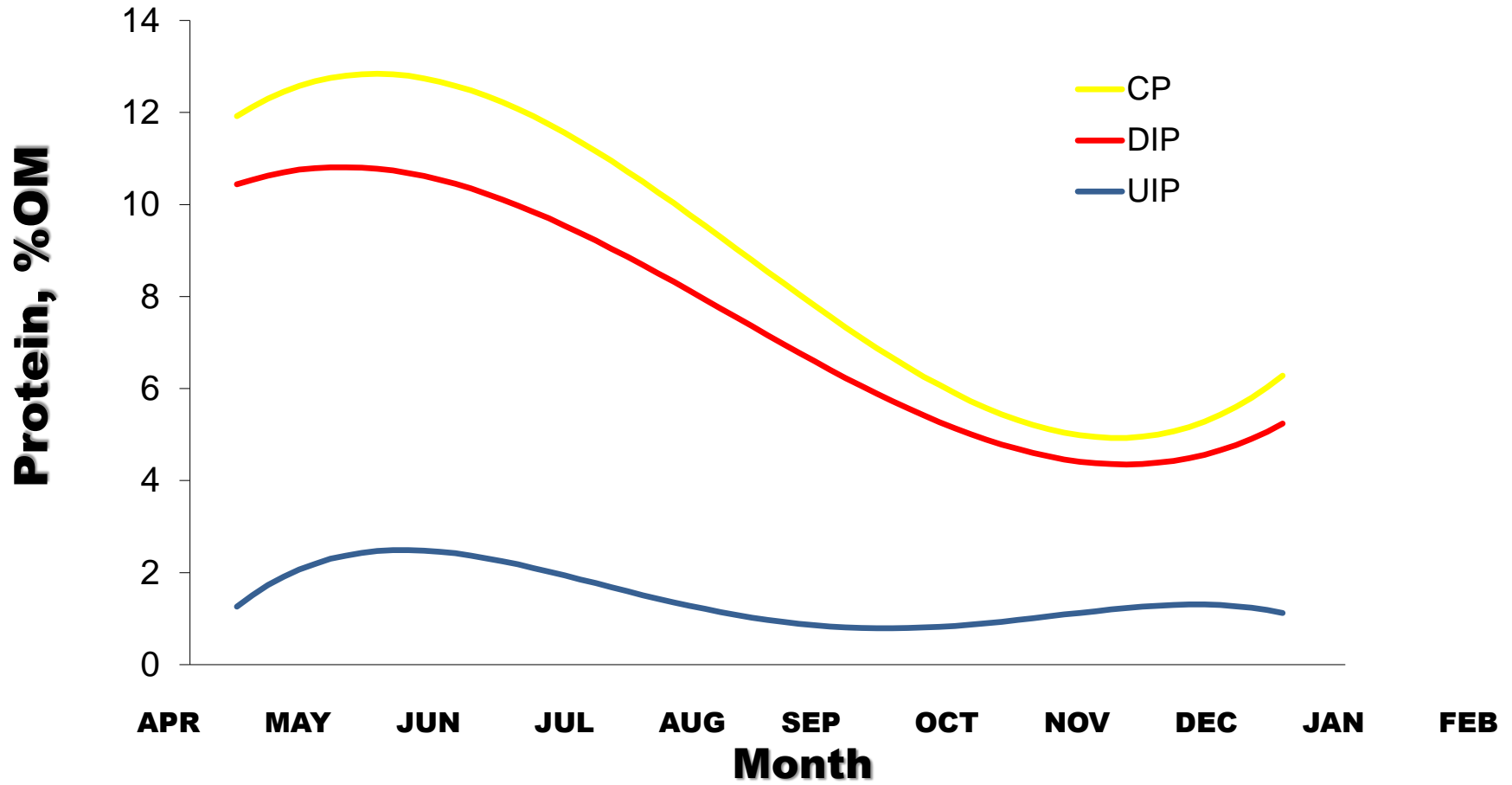
## Energy Requirement



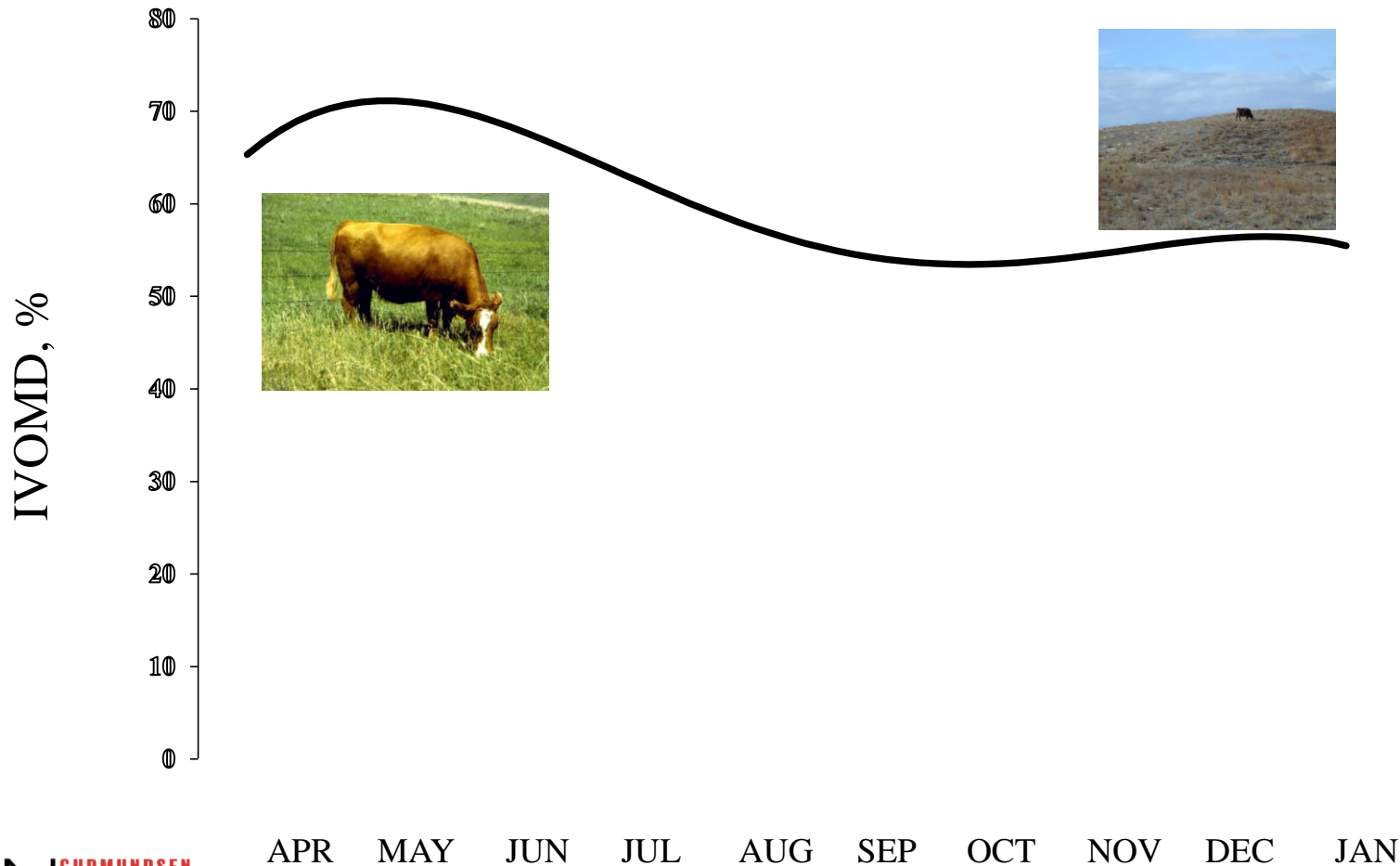
## Protein Requirement



# Crude (CP), Escape (UIP) and Degradable Protein (DIP) in Cattle Diets on Sandhills Range



# *In vitro* Organic Matter Digestibility (IVOMD, % OM) of Cattle Diets on Sandhills Range



# Protein Requirements

- Metabolizable protein (MP) is the protein absorbed in the intestine
  - Bacterial Crude Protein and Undegradable Intake Protein

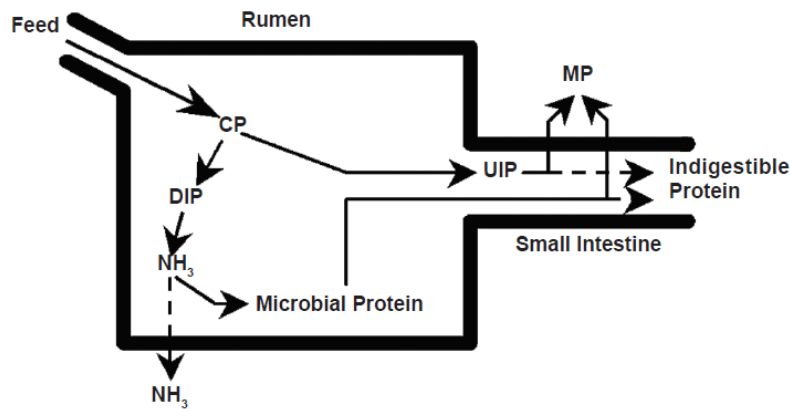


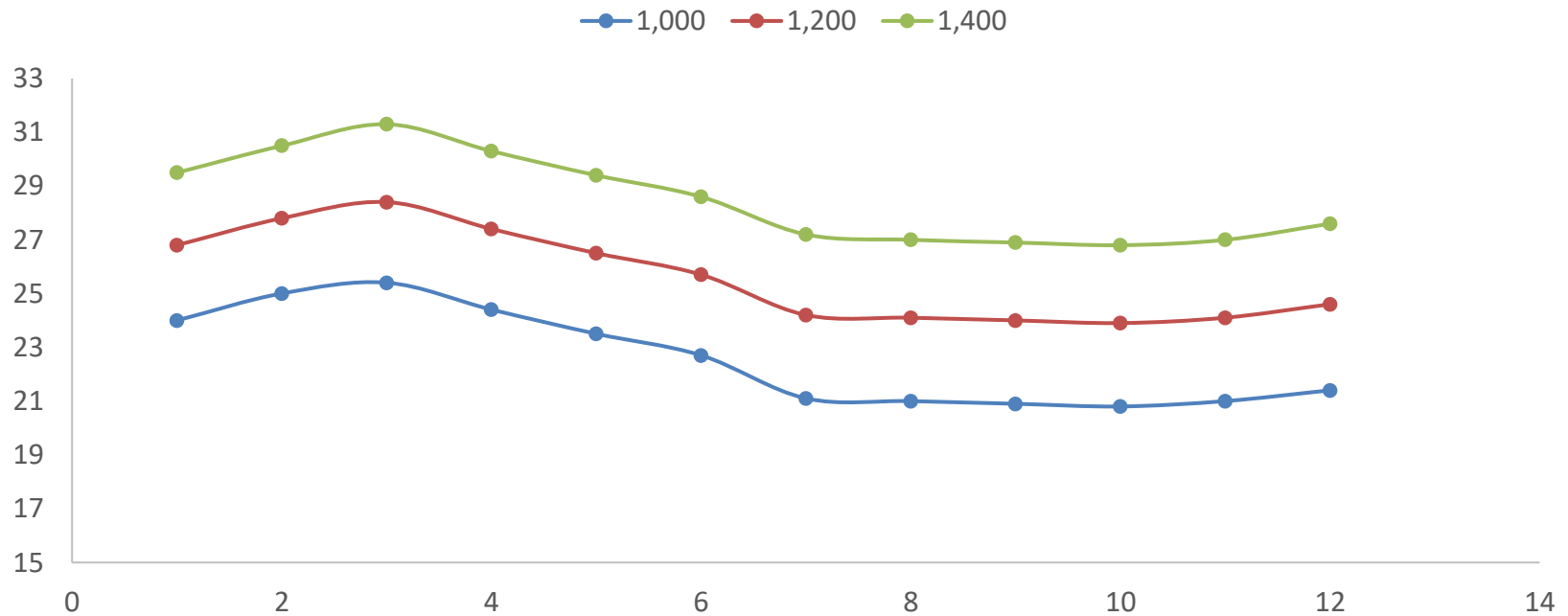
Figure 4. Illustration of protein digestion and absorption in the ruminant. Source: Lalman.

# Animal Nutrient Requirements

- Weight is a function of...
  - Mature size
    - What effect does breed have?



# Cow Size on Dry Matter Intake



500 to 600 lb increase in annual DMI with every 100 lb increase

# Cow Size on Nutrient Requirements

- Increase of 220 lb in cow BW increased NE required by 25% (Olson et al., 1982)
- Increase in cow BW by 27% increased maintenance requirements by 20% (Schmid, 2013)
- Increase of cow BW by 100 lb increases cow costs by \$42 or more due to feed increase (Wiseman et al., 2018)

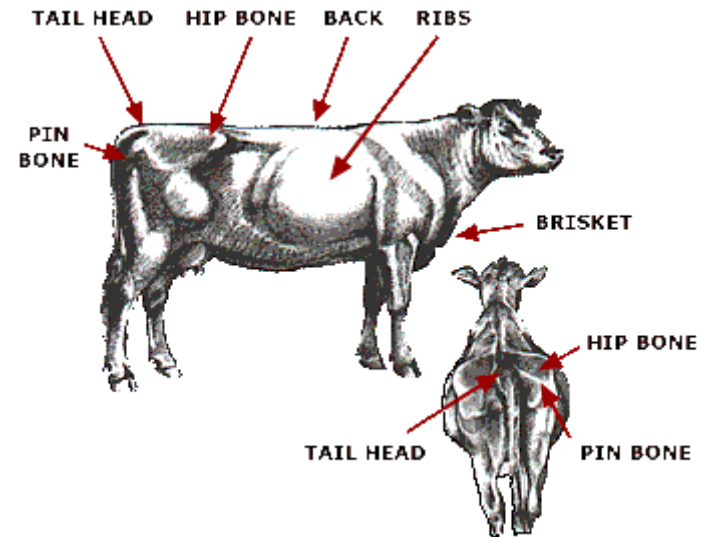
# Determining Animal Nutrient Requirements

- Weight is a function of...
  - Mature size
    - What effect breed have?
  - Body Condition – measures
    - Energy status
    - Reproductive status
  - Body Condition Score is an estimate of the body fat reserves of a cow



# Body Condition Scoring

- Cow weight varies immensely
- Cow “fatness” a better measure of nutritional status
- 9 point scale
  - 1 = almost dead
  - 9 = finished in U.S.



# When should BCS be taken?

- Late summer, early fall
- Weaning time
- 90 days before calving
- Calving time
- Breeding



## Using Cow Body Condition Score to Manage Your Beef Herd

Brent Plugge, Extension Educator | Travis Mulliniks, Extension Beef Specialist

# When should BCS be taken?

- Weaning (Pre-calving)
  - Nutritional deficiencies during late gestation can negatively affect
    - Colostrum production
    - Milk production
    - Future reproductive performance
    - Future subsequent progeny performance

# BCS 90 to 100 days prior to calving

Body Condition		Weight Gain Needed				
At Weaning	Needed at Calving	Fetus and Placenta, lb	Body Weight, lb	Total Weight, lb	Days to Calving	ADG
5	5	100	0	100	90	1.1
4	5	100	75	175	180	1.0
4	5	100	75	175	90	1.9
4	5	100	75	175	60	2.9
3	5	100	150	250	180	1.4
3	5	100	150	250	90	2.8
3	5	100	150	250	60	4.2

# Body Condition Score

- Indicator of PPI
- Need 82 days to maintain 365 day cycle
- Condition score 5 to 5.5 is the target
- BCS > 6 is “wasteful”

BODY CONDITION RELATES TO INTERVAL FROM CALVING TO FIRST HEAT

BCS	Post-Partum Interval (Days)
3	89
4	70
5	59
6	52
7	31

80

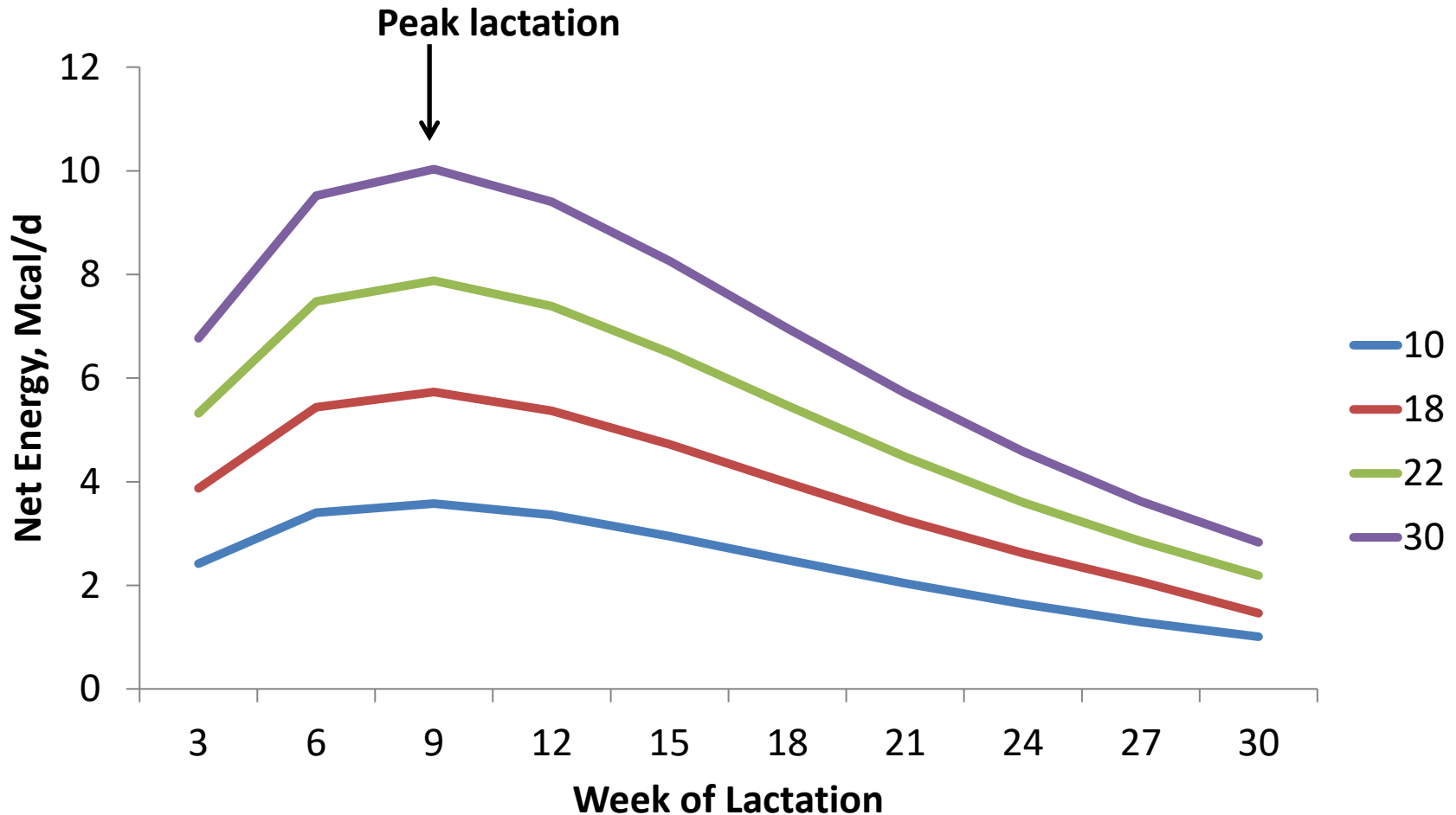
55

# Body Condition Score and BW change

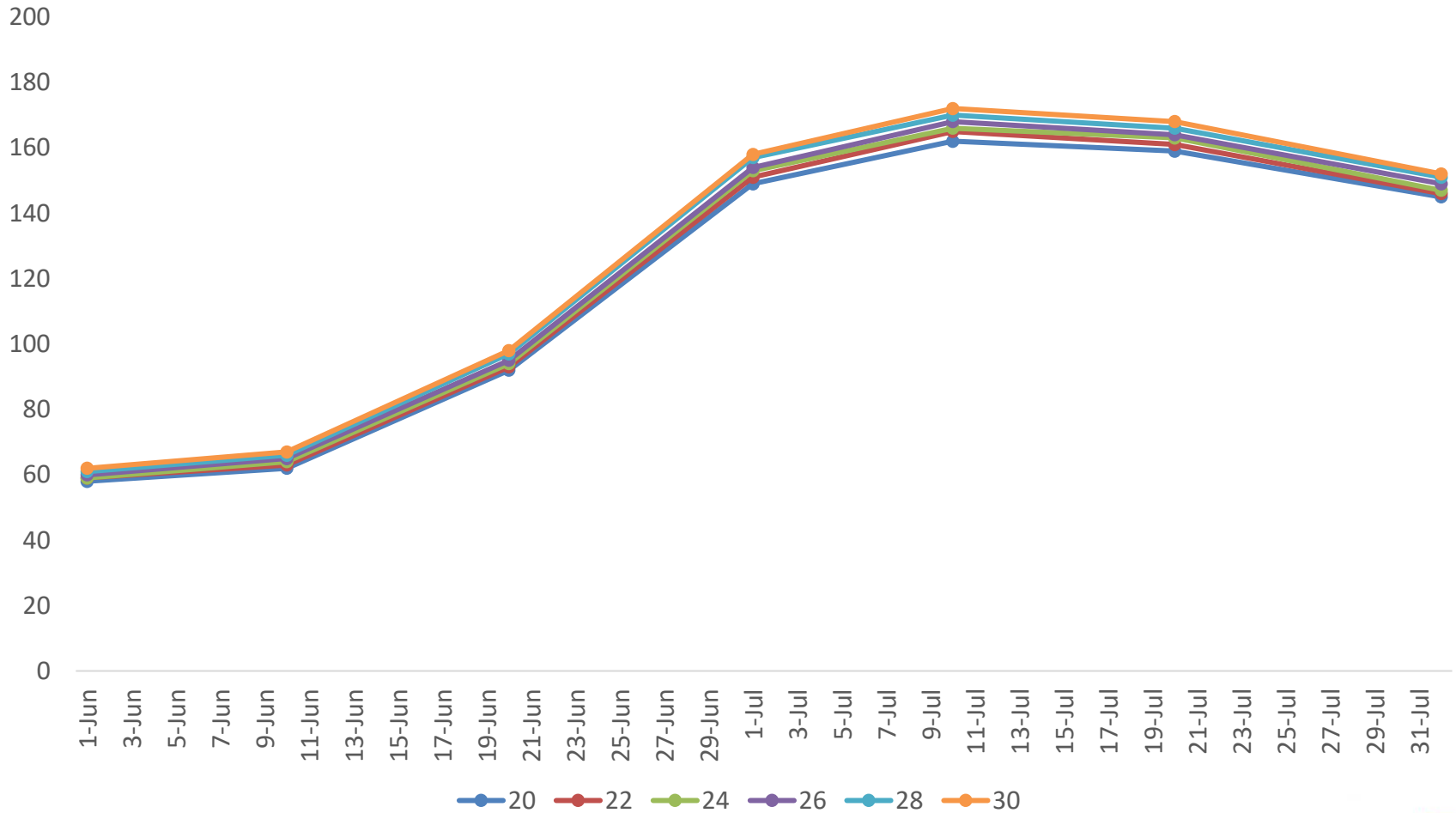
BCS status	Pregnancy %
Thin (< 5) and increasing BW	100
Fleshy (> 5) and increasing BW	75
Thin (< 5) and decreasing BW	69
Fleshy (> 5) and decreasing BW	94
Moderate (4.5 – 5.5) and maintaining	100

Houghton et al (1990)

# Net Energy Required for Milk Production



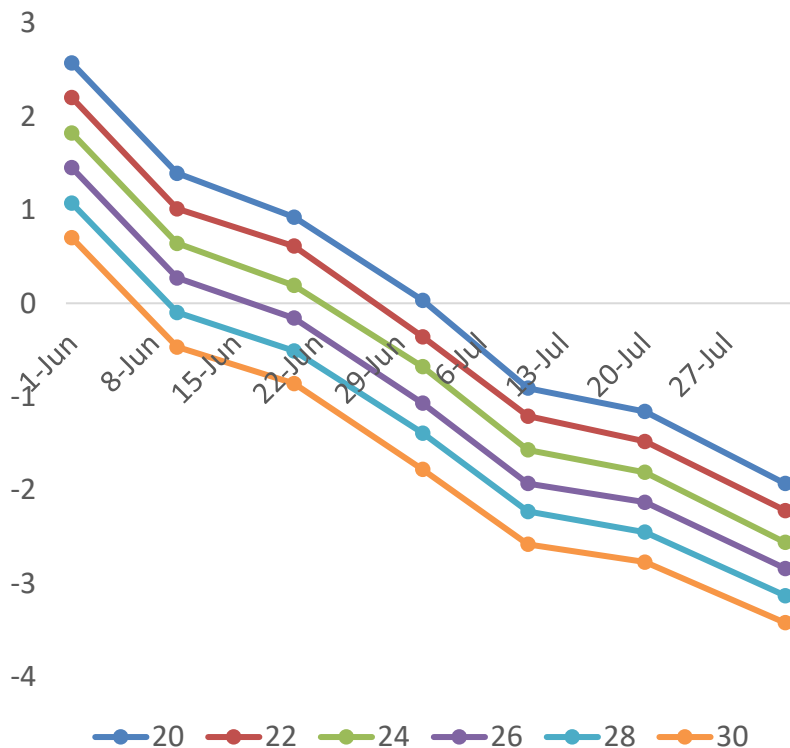
# Rumen Degradable Protein Requirement for March Calving Cow from 20 to 30 lb of milk



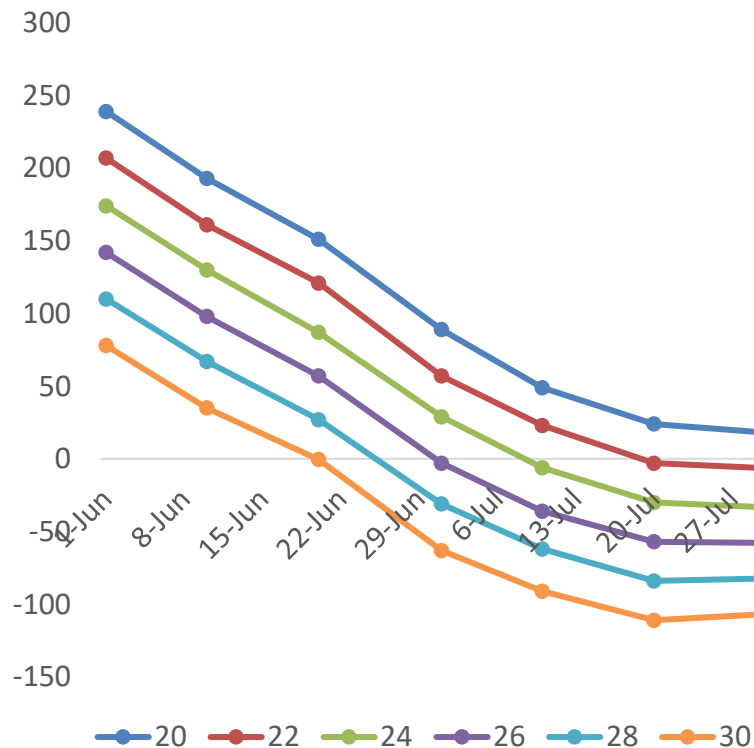


# Nutrient Deficiency for March Calving Cow

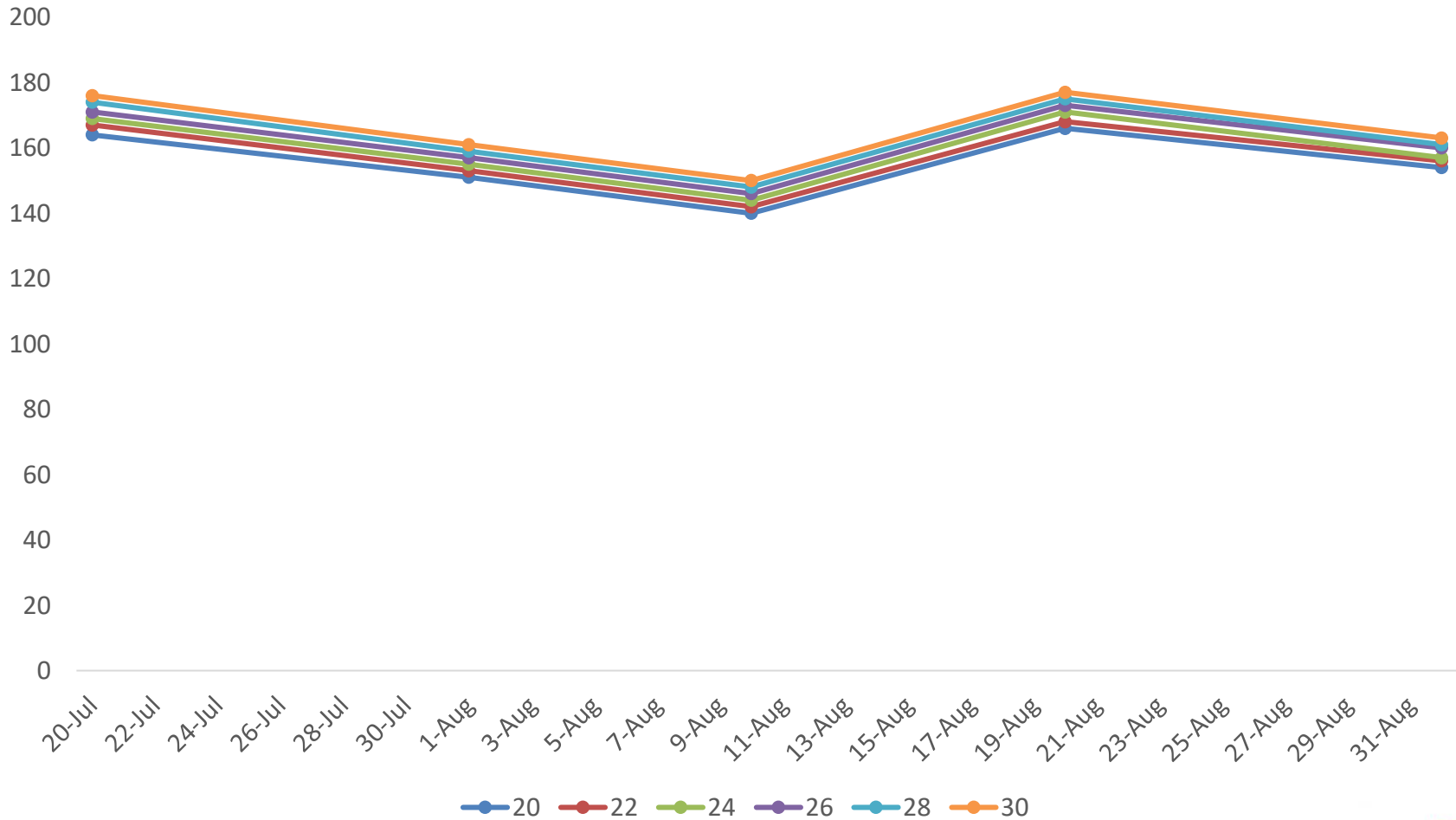
## Nem Balance



## MP Balance

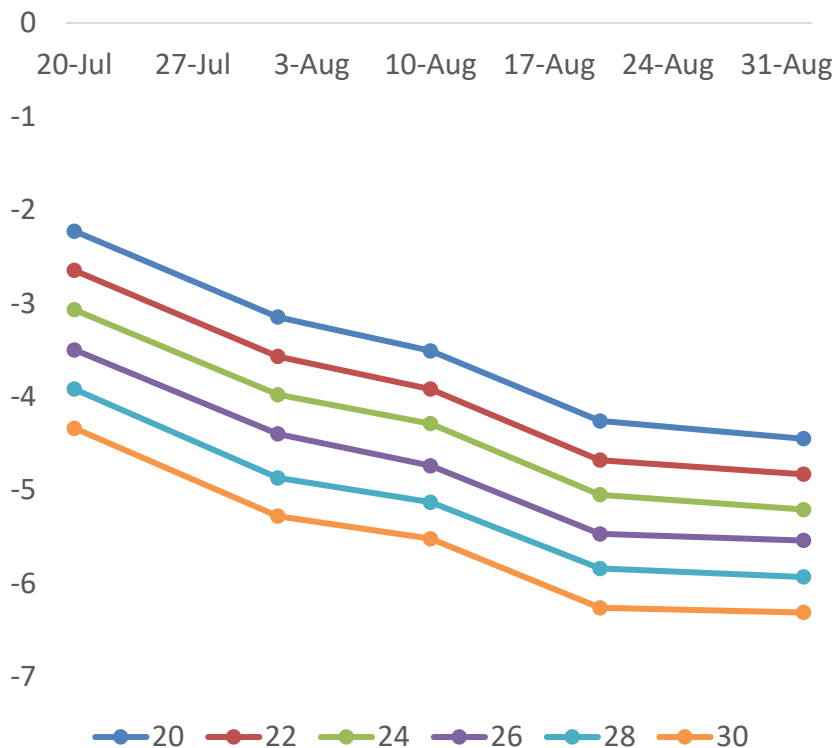


# Rumen Degradable Protein Requirement for May Calving Cow from 20 to 30 lb of milk

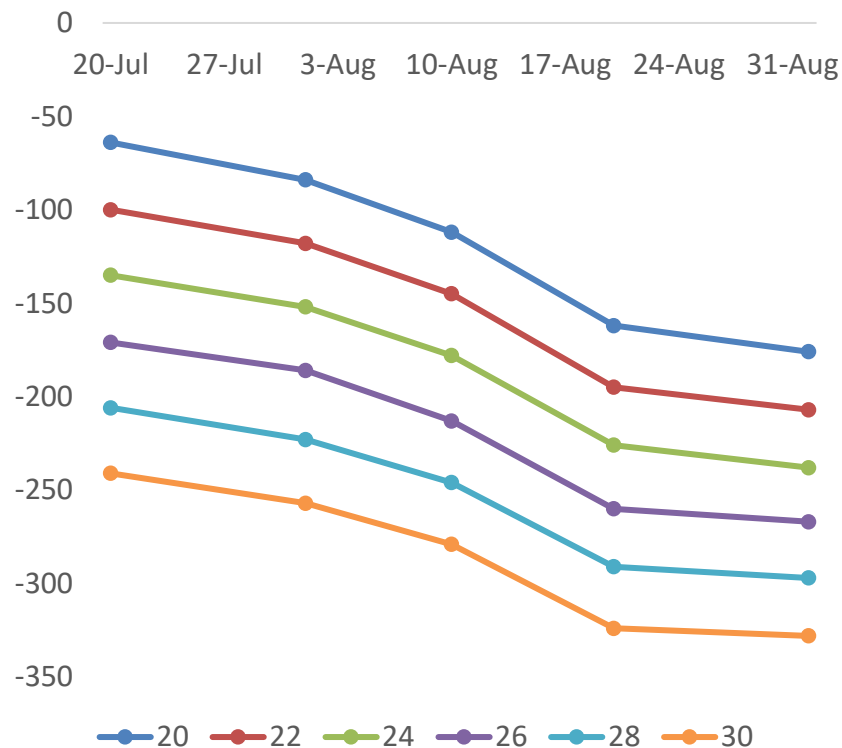


# Nutrient Deficiency for May Calving Cow

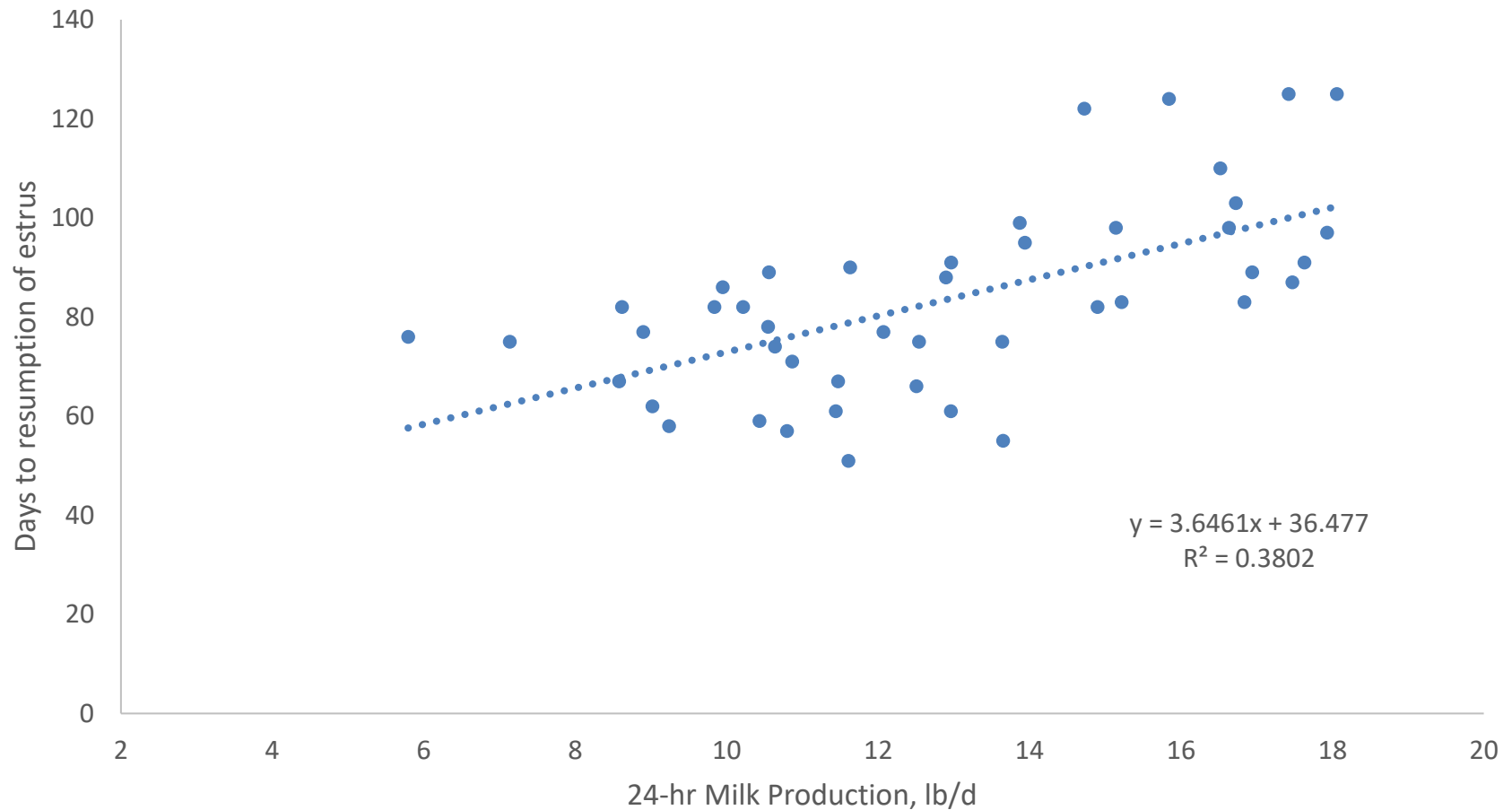
## Nem requirement



## MP Requirement



# Milk Production and Resumption of Estrus in Young Cows In NM



# Milk vs Maintenance



More milk = higher year-long maintenance requirements (NEm)



Related to greater visceral organ mass relative to empty body weight

Rumen, small and large intestine, liver, heart, kidneys

# Milk Potential and Intake

	Cow A	Cow B	Difference
Body Weight	1,100	1,100	-
Milking Potential	Low	High	-
Total lb of TDN/cow/year	3,726	4,159	433
Total lb of forage/cow/year	6,774	7,561	787

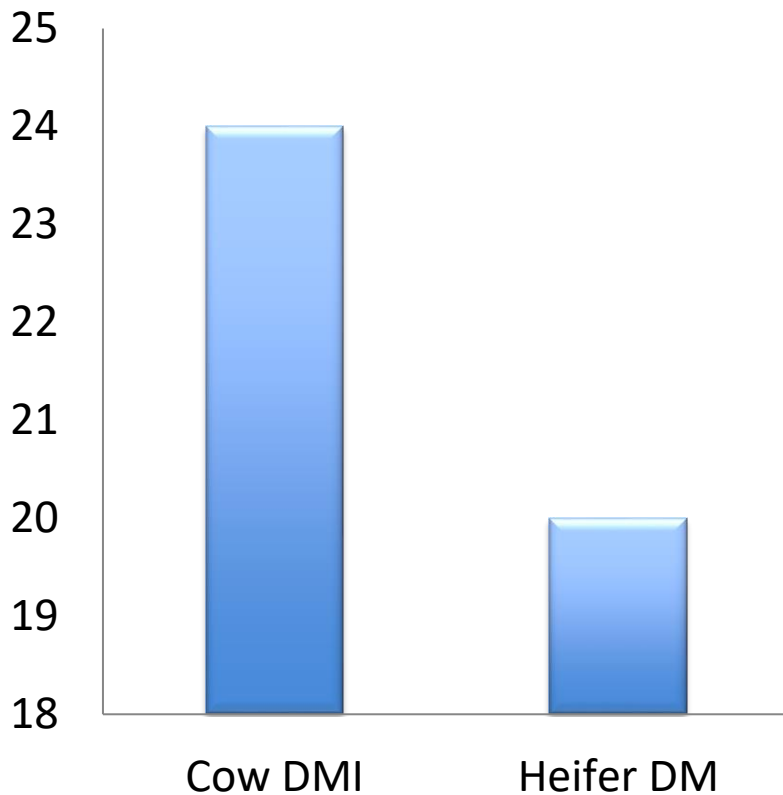
- Nearly 800 lbs more forage per year
- In a 100-cow herd
  - 78,700 pounds of additional forage per year to support a higher level of milk

# Effect of Cow Age on Milk Production

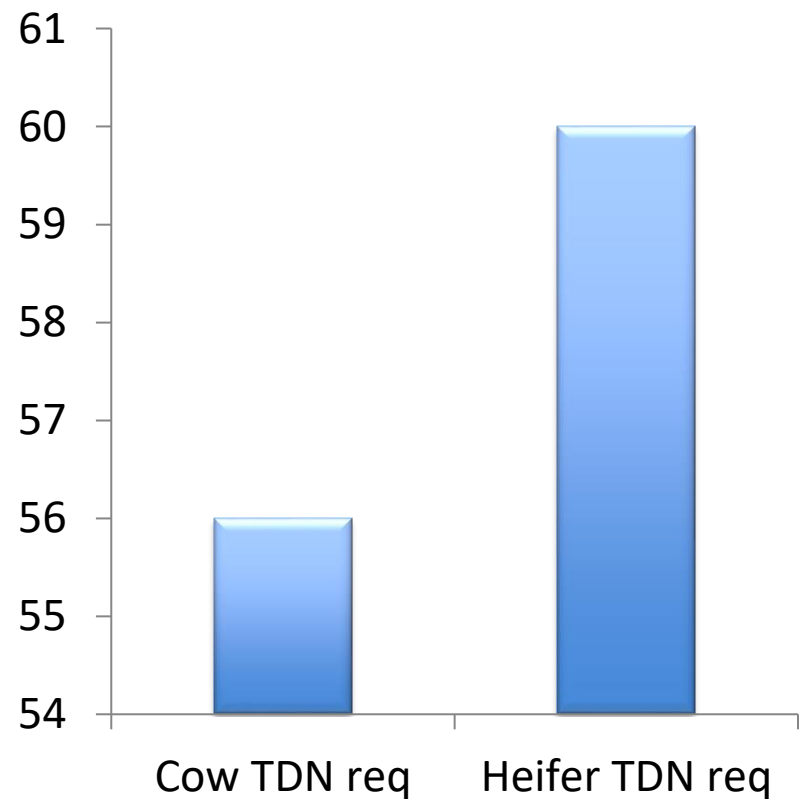
- Compared to a 4-yr-old cow, milk production is about:
- 26% lower for a 2-yr-old cow
- 12% lower for a 3-yr-old cow

# Comparison of Cow vs 1<sup>st</sup> Calf Heifer Energy Requirement

Lbs, Intake



TDN, % required





# Evaluation of Changing Mature Size and/or Milk Production

- Nutrient requirements increase
  - Forage availability becomes a concern
    - If forage is still adequate, could increase number of smaller and/or lower milking cows
    - Change in forage management and costs to meet the increase in requirements

# Evaluation of Changing Mature Size and/or Milk Production

- Reproduction tends to decrease without increase in feed inputs
- Marketing Considerations
  - \$/cwt of salable calf: 450 vs 700 lb
  - Total income not just calf weaning weight

# Critical Periods: Late Gestation

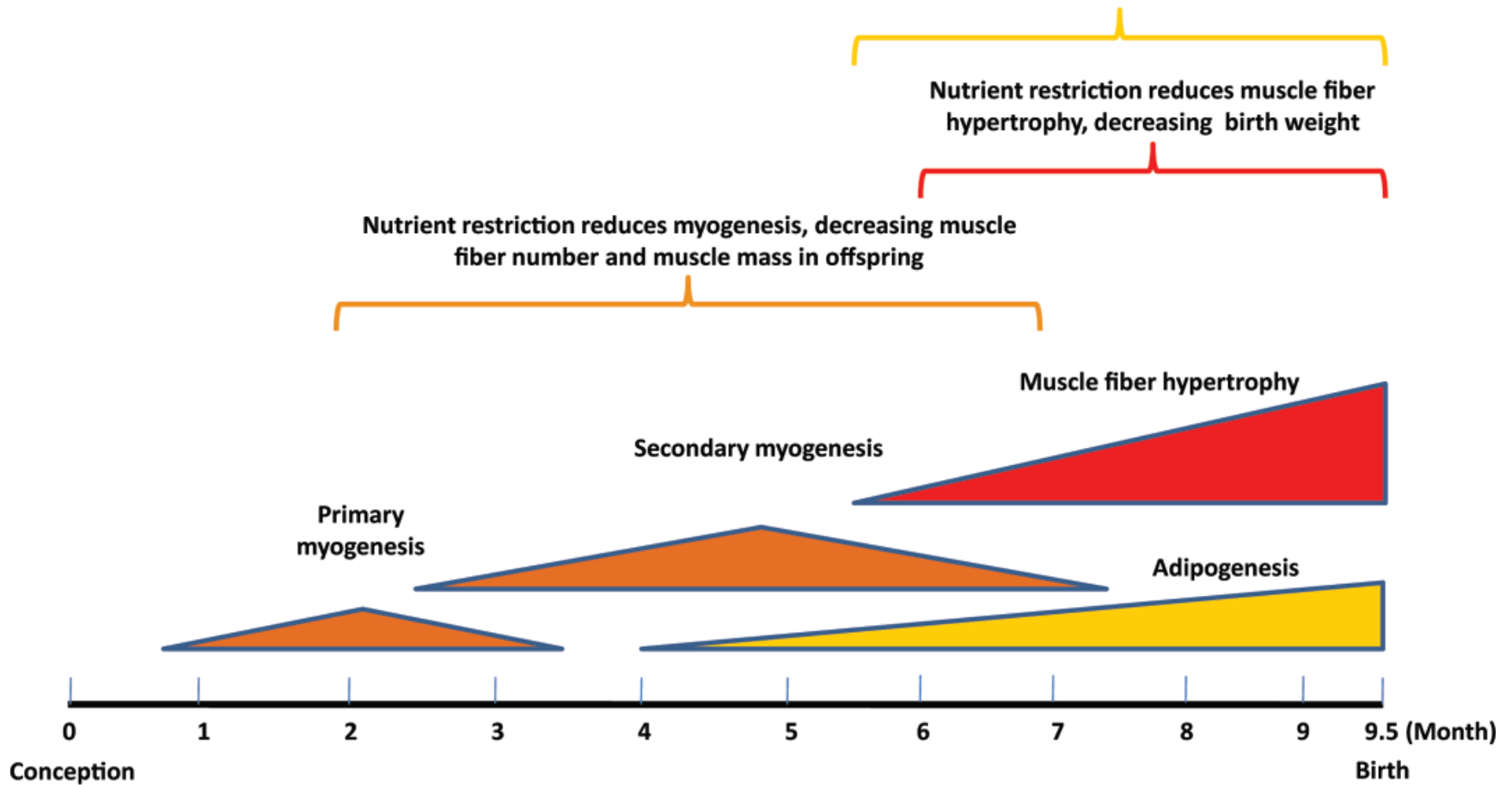
- Cows should maintain body weight
  - Fetal development
  - Calf growth is exponential
    - Major fetal growth
    - 1 lb gain per day for the last 70 - 100 days

# Estimates of Energy and Protein for Pregnancy

Day of Gestation	NEm (Mcal/d)	Available Net Protein, g/d
130	0.327	9.1
160	0.634	17.5
190	1.166	32.2
220	2.027	56.0
250	3.333	95.2
280	5.174	156.1

NASEM, 2016

# Fetal Development



# Nutrient Requirements - Overall

- Order of Greatest Requirements
  1. Lactating cow
    1. First calf heifer – greatest requirement on a percent body weight
    2. Mature lactating cow
  2. Late gestating cow
  3. Growing heifer/steer

# Nutrient requirements

- As nutrient requirements increase (e.g., for pregnancy and lactation), the quantity and quality of forage needed by the cow increases

# Dry Matter Intake in Beef Cows

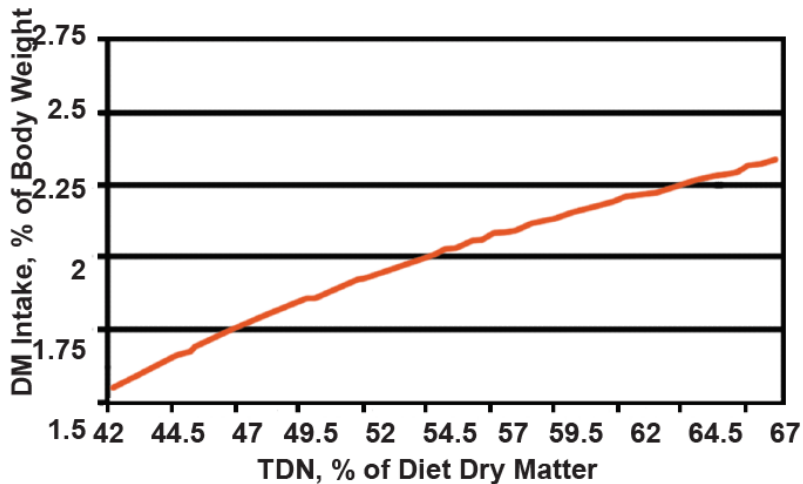


Figure 16.2. The relationship of forage digestibility to dry matter intake in beef cows. Source: NRC.

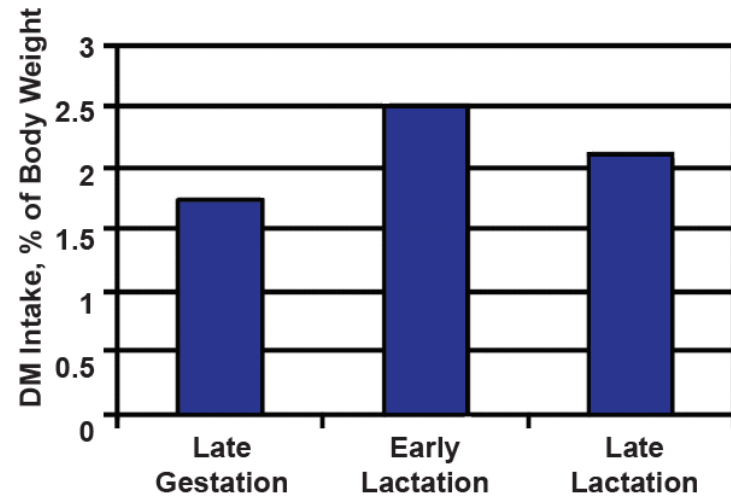


Figure 16.3. Dry matter intake, expressed as percent of body weight, of beef cows consuming low quality forage during three different stages of production. Source: Johnson et al.



# Forage Capacity in beef cows

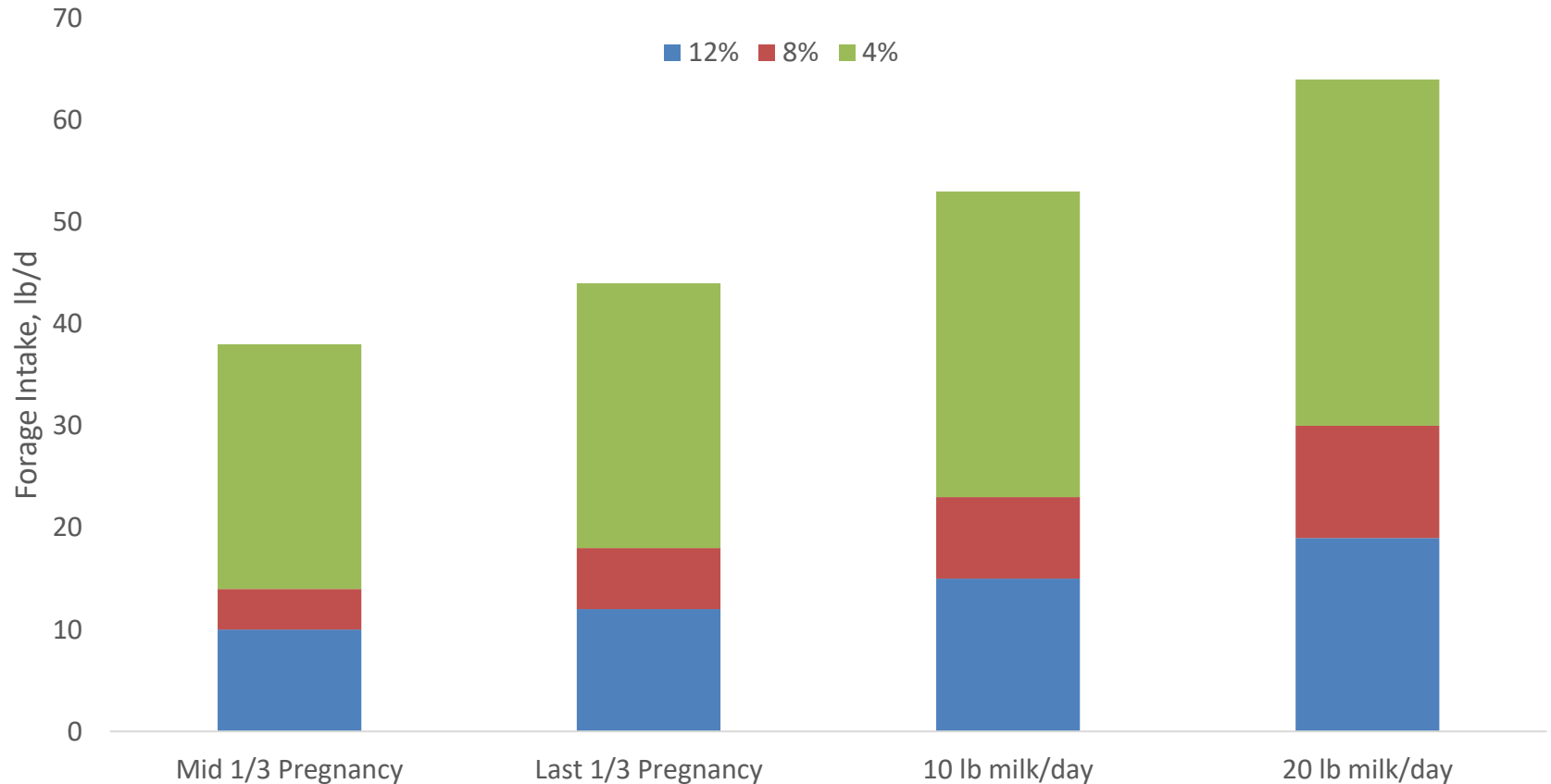
Table 1. Forage capacity of beef cows<sup>a</sup>.

<i>Forage Type and Maturity</i>	<i>Stage of Production</i>	<i>Forage Dry Matter Intake Capacity, % of Body Weight</i>
Low quality forage (< 52% total digestible nutrients)	Dry	1.8
Dry winter forage, mature legume and grass hay, straw	Lactating	2.2
Average quality forage (52% to 59% total digestible nutrients)		
Dry summer pasture, dry pasture during fall, late-bloom	Dry	2.2
legume hay, boot stage and early-bloom grass hay	Lactating	2.5
High quality forage (> 59% total digestible nutrients)		
Mid-bloom, early-bloom, and prebloom legume hay,	Dry	2.5
preboot stage grass hay	Lactating	2.7
Lush, growing pasture	Dry	2.5
	Lactating	2.7
Silages	Dry	2.5
	Lactating	2.7

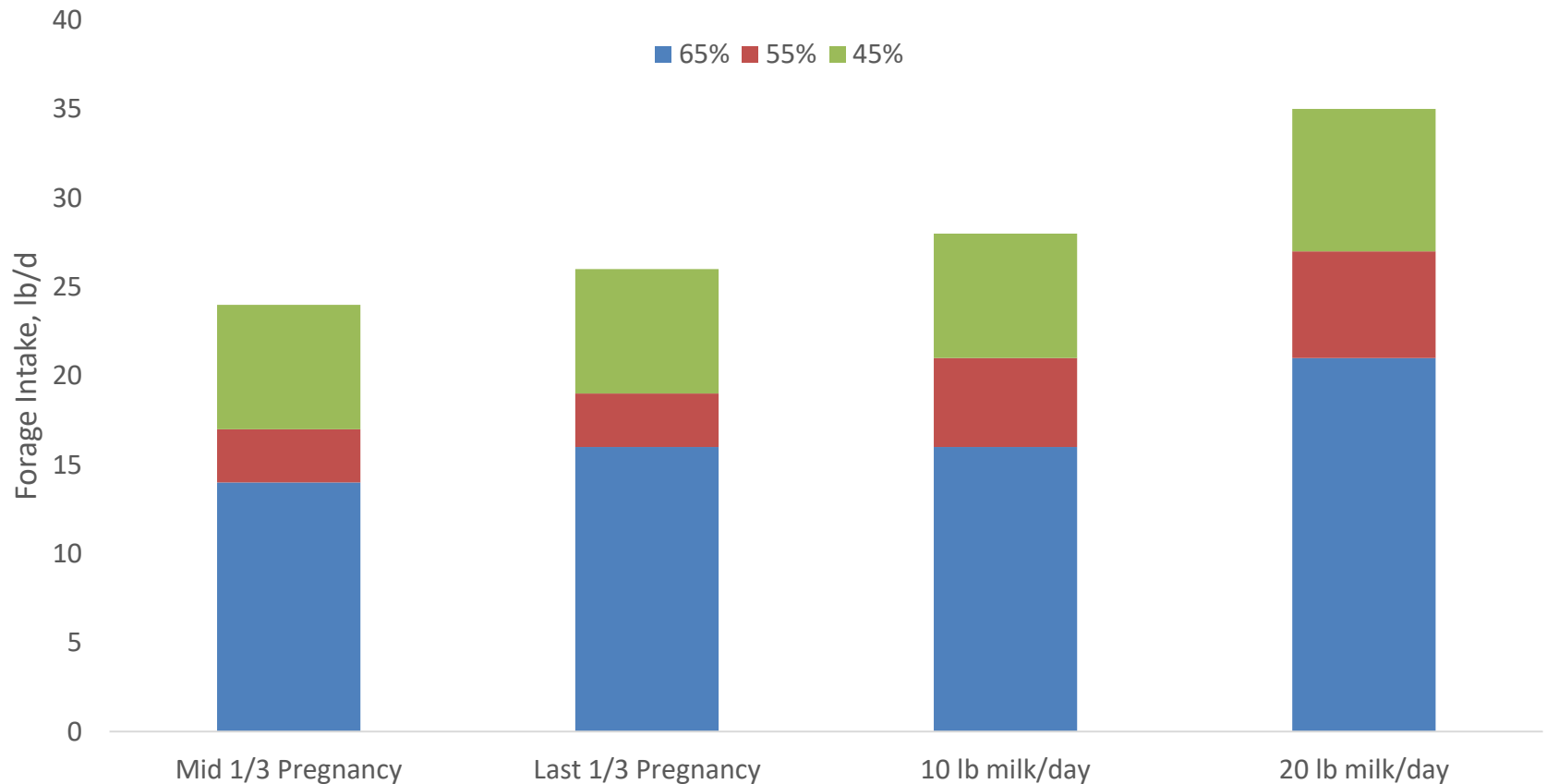
<sup>a</sup> Intake estimates assume protein requirements are met by the forage or through supplementation when forage protein is not adequate. When protein requirements are not met, forage intake will be lower than the values shown in the table.

Source: Hibbard and Thrift.

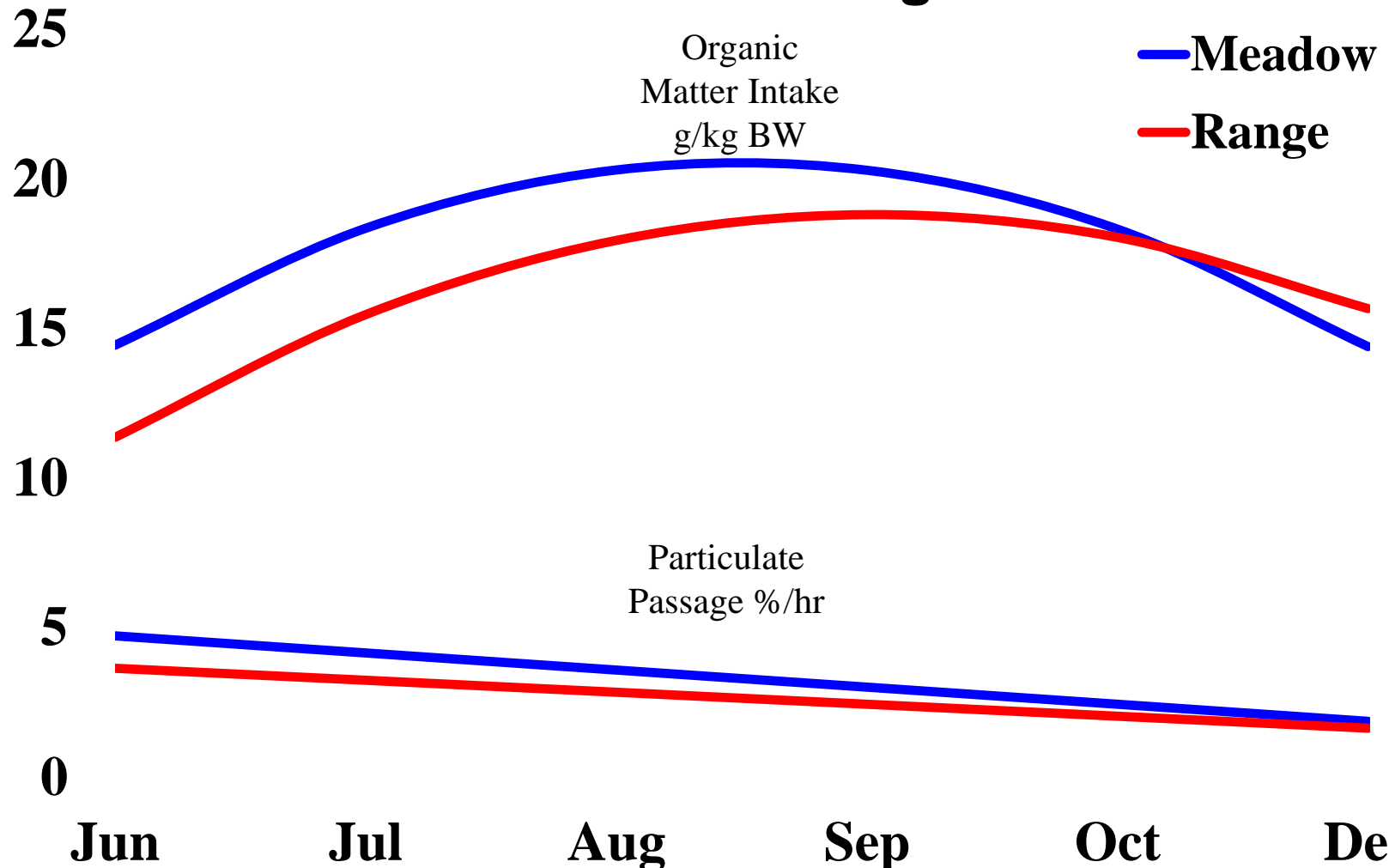
# Forage Intake Needed to Meet Protein Requirements for Pregnancy and Milk



# Forage Intake Needed to Meet Energy Requirements for Pregnancy and Milk

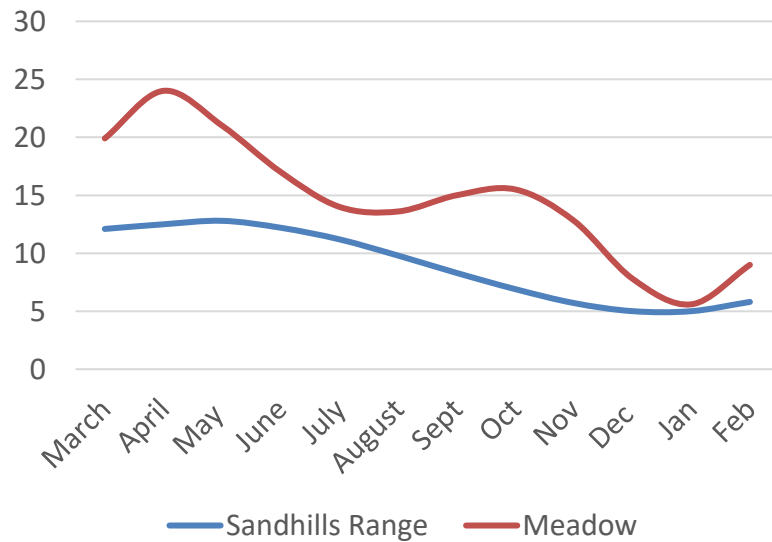


# Forage Organic Matter Intake and Particulate Passage Observed Using Steers Grazing Sandhills Meadow or Range

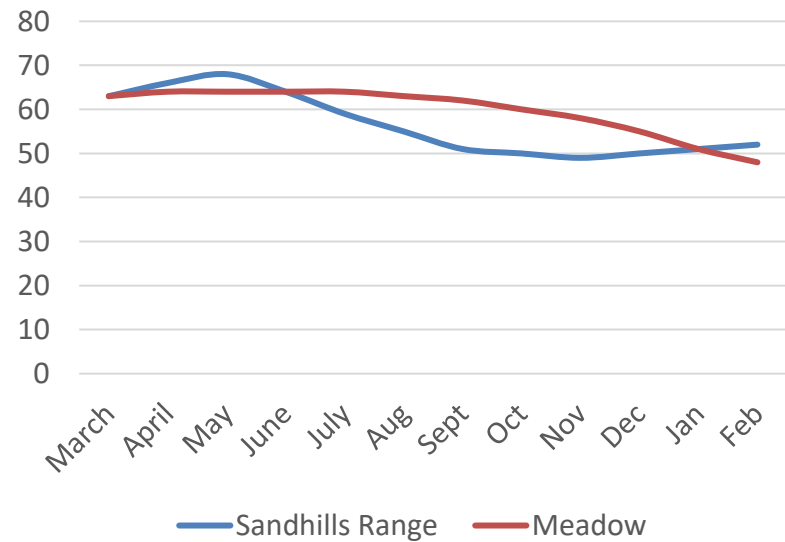


# Forage Quality of Range and Meadow

## Crude Protein, %



## TDN, %



# Factors affecting feed intake

- Physiological
  - Lactation
    - Does milk production drive intake or does intake drive milk production?
      - Answer: Milk production drives intake
    - Lactating animals increase feed intake by 35 – 50%
    - $DMI = NE_L \text{ required} / NE_L \text{ concentration of the diet}$

**About 10 pounds of forage is conserved  
for each day a calf is weaned  
(10 lbs forage = .4 day grazing for a dry cow)**



**Weaning**

# Factors affecting feed intake

- Physiological
  - Pregnancy
    - 1.5 to 2% decrease in intake per week during the last 14 weeks
  - Body weight
    - Increase in body weight, increases intake
  - Body composition
    - As % of body fat increases, intake decreases
      - Typically used in feedlots for appropriate slaughter conditions



# Factors affecting feed intake

- Physiological
  - Sex of animal
    - Seems to have limited effects
    - Heifers less than 500 lbs = 10% less intake than steers
  - Age
    - 10% greater intake for cattle started on feed as yearlings
    - Cows of similar age and nutrient requirement decreases variation
  - Breed/Genetics
    - Breed differences are likely due to mature size
      - Milk production potential
      - Growth potential

# Questions

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