A Behavioral Basis For Understanding Diet Selection In Grazing Animals

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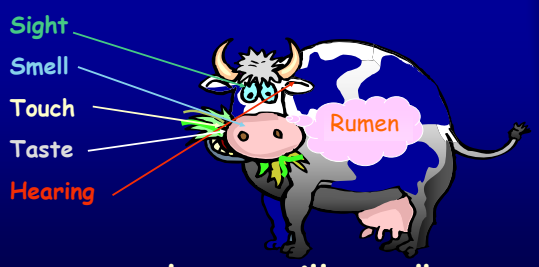
Every wonder why your animals eat what they eat? Don't eat what you think they should eat? Or worse yet, don't eat what your fancy smanchy computer-based ration balancing program tells you they require?

Well, I have some bad news for you if you think it's the animal that is wrong!

All the parts are still here…



…and are still used!

Postingestive Feedback

If they don't like it, they are not likely to eat it again!

Disclaimer

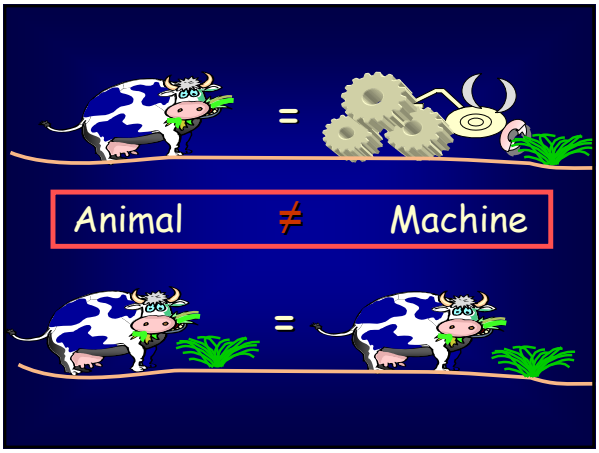
Behavioral principles have universal application!

Herbivores

Carnivores

Omnivores

Biscuitivores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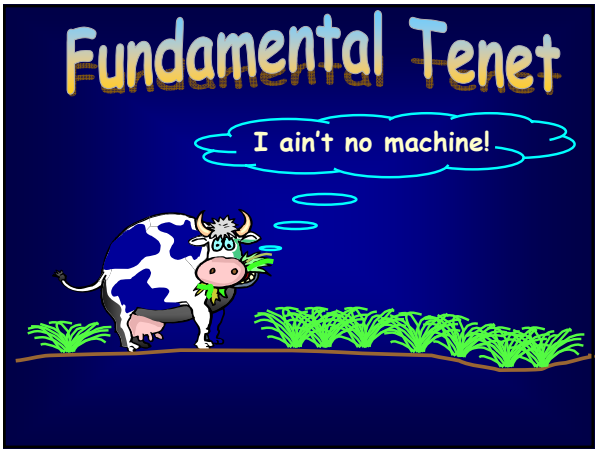
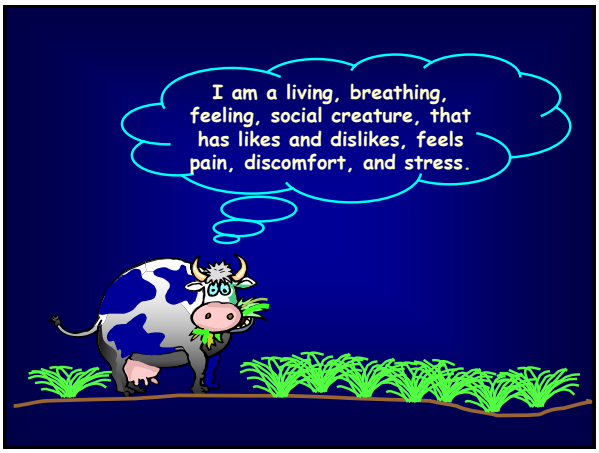
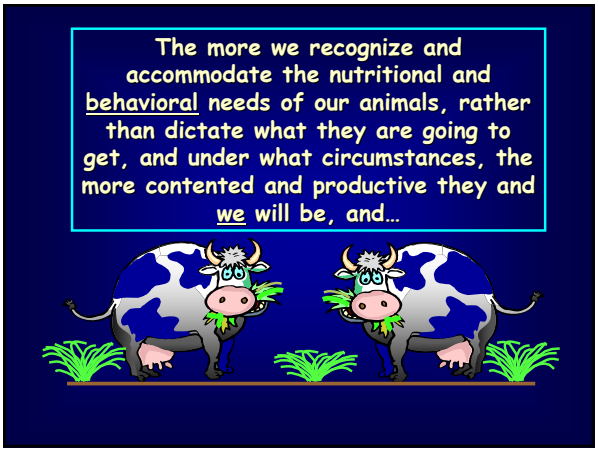
Animal ≠ Machine
=

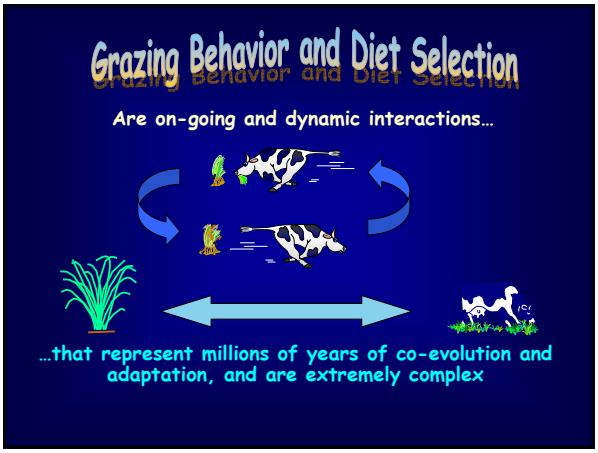

Fundamental Tenet
I ain't no machine!


I am a living, breathing, feeling, social creature, that has likes and dislikes, feels pain, discomfort, and stress.

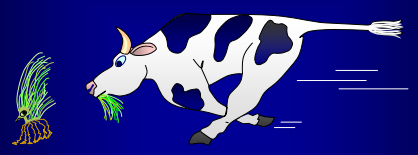
I prefer familiar foods to novel foods, mixed diets to monotonous diets, familiar environments to unfamiliar environments, and furthermore, I prefer to…

to be with companions rather than with strangers!


The more we recognize and accommodate the nutritional and behavioral needs of our animals, rather than dictate what they are going to get, and under what circumstances, the more contented and productive they and we will be, and…

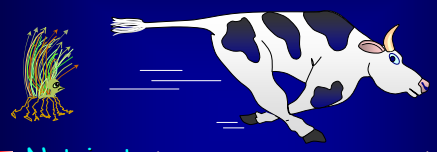

Grazing Behavior and Diet Selection
Are on-going and dynamic interactions…
…that represent millions of years of co-evolution and adaptation, and are extremely complex

Animals Influence Plants



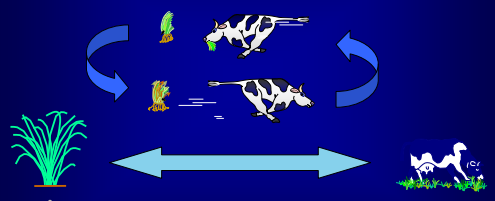
- Defoliation
- Trampling
- Altering nutrient dynamics

Plants Influence Animals



- Nutrients (energy, protein, vitamins, and minerals)
- Defense mechanisms (stickers, prickers, toxins, thorns, and growth form)
- Spatial and temporal variation in: forage quality, quantity, toxicity, and availability

Plant-Animal interactions represent natural patterns and processes...



...that have withstood the test of time.
They have an undisputable wisdom!

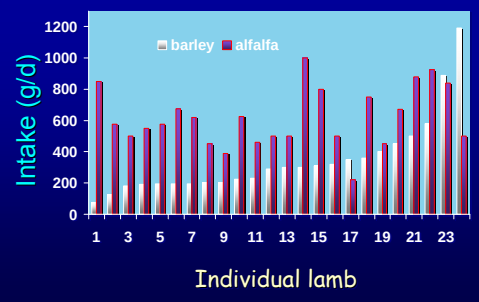
Every Individual is Unique

They look different: some are larger, some are smaller, some are different colors.

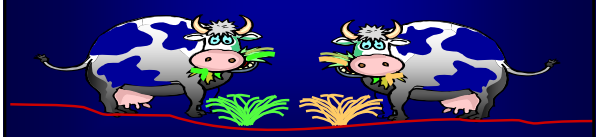
And if you think they look different on the outside, you should see what they look like on the inside!

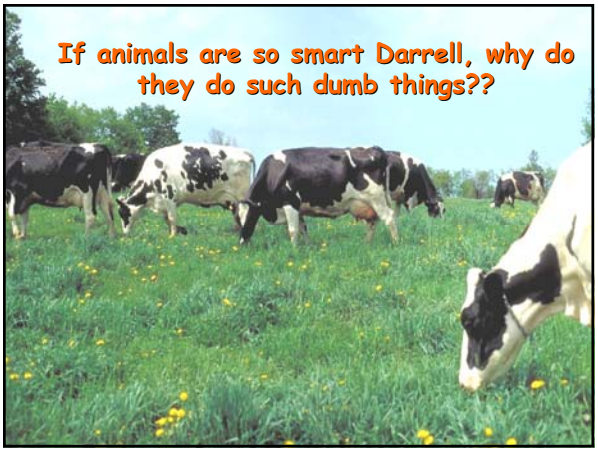
The result of these differences is no two animals is likely to eat the same foods and in the exact same amounts

Food Preferences



Foraging behavior and diet selection are unique to each individual creature, even though the individuals are the same species.





Making Sense Of Animal Behavior Is Easy

Behavior Is A Function Of It's Consequences!

- Positive Consequences Increase The Likelihood Of A Behavior
- Negative Consequences Decrease The Likelihood Of A Behavior

E.L. Thorndike, 1911

"The law of effect"

"Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur; those which are accompanied or closely followed by discomfort to the animal will, other things being equal, have their connections with that situation weakened, so that, when it recurs, they will be less likely to occur.

Forage quality

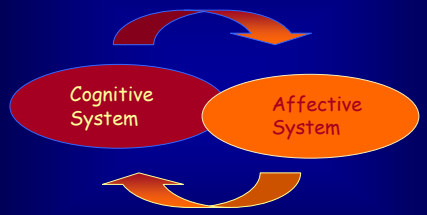
- Black medic
  - CP= 25.6
  - ADF= 14.5
  - NDF= 24.1
  - NEL= .79
- White clover
  - CP= 21.8
  - ADF= 26.2
  - NDF= 41.6
  - NEL= .69

Forage quality

- Dandelion
  - CP= 20.8
  - ADF= 18.0
  - NDF= 41.5
  - NEL= .65
- P. ryegrass
  - CP= 22.3
  - ADF= 29.4
  - NDF= 51.0
  - NEL= .59

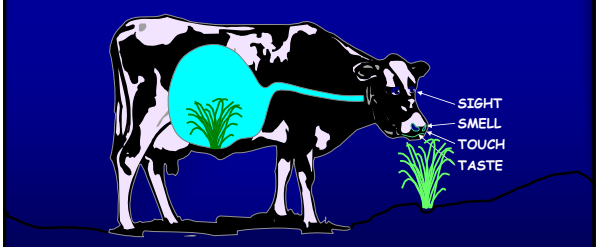
So How Do Animals Learn What To Eat?

Animals process information about foods through two interrelated systems…



…with taste having a major influence on both

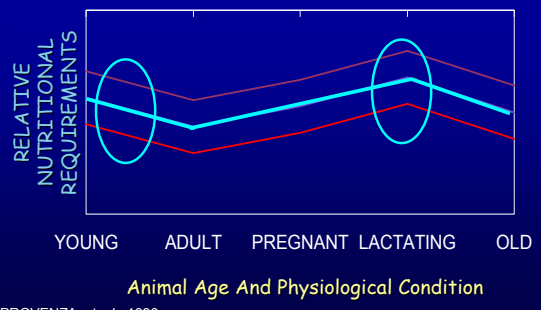
Cognitive Or Voluntary System



This System Integrates The Senses Of Sight, Smell, Touch And Taste With Information Gained From Mom, Peers, And Trial And Error Experience To Make Conscious Choices Concerning What To Or What Not To Eat

Learning Through Mom

Animal nutrient requirements vary with age and physiological condition



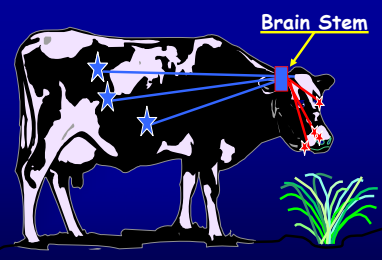
PROVENZA, et. al., 1998

Affective Or Involuntary System

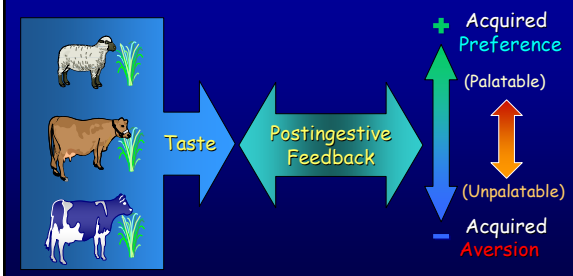
This System Represents A Sub-Conscious Connection Between An Animal's Brain And Gut That Links The Taste Of A Particular Food With Its Unique Postingestive Consequences

Neural Convergence

Neural Convergence



Learning through consequences



So what does it mean when we say a food is palatable or preferred?

Preference

Has traditionally been defined in terms of an animal's response to a particular food i.e., if when given the choice between two foods, an animal eats one food but not the other, it is presumed the animal prefers one but not the other.

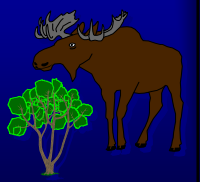
What do we mean by palatability?

Has traditionally been defined as an attribute of a food i.e., if it smells good, tastes good, has a wonderful texture etc., the food is considered palatable.

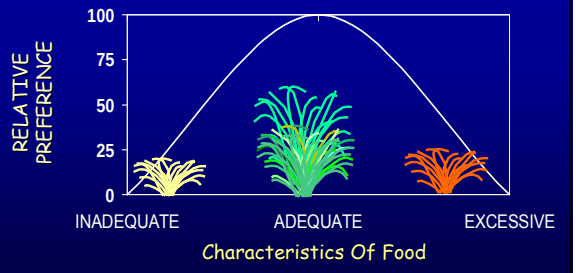
However, these definitions are not exactly right! Because there is no such thing as a food that is <u>always</u> palatable and <u>always</u> preferred

So what is palatability?

Palatability is the interrelationship between flavor and postingestive feedback from nutrients and toxins, determined by an animal's age & physiological condition, a food's chemical characteristics, and an animal's experiences with the food.



Preference depends on how adequately a food satisfies an animal's particular nutritional needs



PROVENZA, et. al., 1998

Meal to meal preference for energy and protein depends on whether energy and protein requirements were satisfied during previous meals

ANIMAL PREVIOUSLY CONSUMED:	PREFERENCE FOR: ENERGY	PROTEIN	WATER
WATER	ENERGY >	PROTEIN >	WATER
ENERGY	↓	↑	NO CHANGE
PROTEIN	↑	↓	NO CHANGE

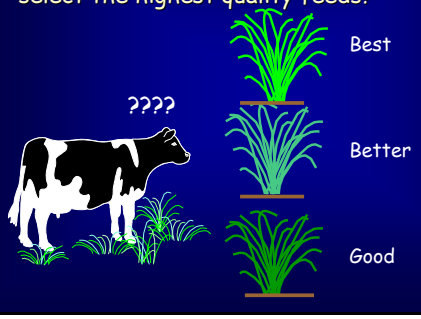
PROVENZA, et. al., 1998

Palatability and preference are dynamic

"Hey, we're sick of clover, we want grass"

It has been stated "animals select the best and leave the rest"

However, the question is do animals always select the highest quality feeds?



Nutrient profile of 9 inch tall orchardgrass 10/5/98

	CP	NDF	NEL
TOP	27.4	38.5	.79
MIDDLE	22.9	44.6	.76
BOTTOM	14.0	60.0	.67

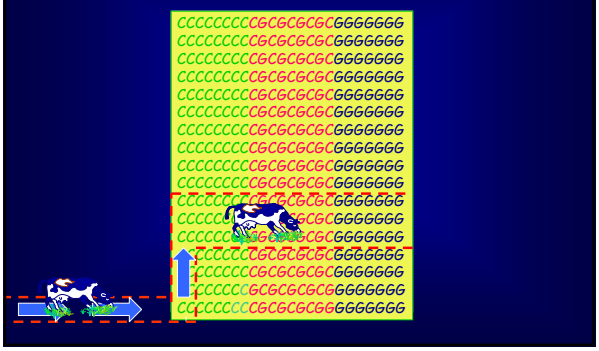
Anecdotally, these observations indicate when given a choice, cows can and do discriminate among alternatives and attempt to balance nutrient intake to maintain dietary homeostasis.

Research Question

If I change the ratio between crude protein and energy in the barn ration, i.e., the grain, will the cows alter the composition of the diet they select from pasture to compensate?

Pasture Research Design

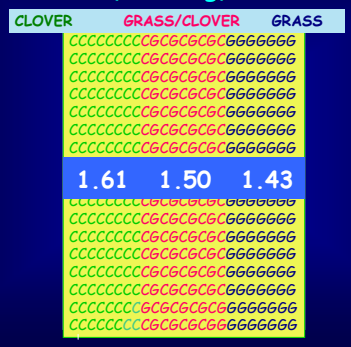
CLOVER GRASS/CLOVER GRASS



Pasture Crude Protein (%)

CLOVER GRASS/CLOVER GRASS

Pasture Net Energy for Lactation (Mcal/kg)



Grain Mixes

	CP	NE_L
Mix 1	11%	1.83 Mcal/kg
Mix 2	21%	1.83 Mcal/kg

Research Design
(A-B-A Reversal)

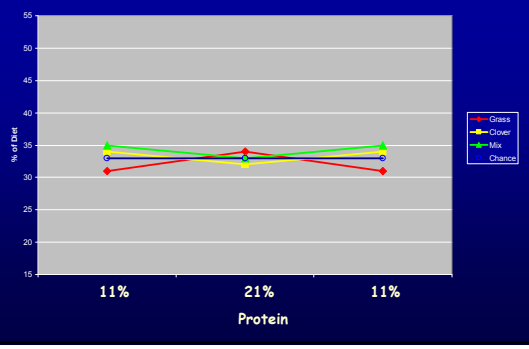
A=days 1-4 Cows were fed morning and night 10 pounds of an 11% CP pelleted grain mix and turned out to graze with no other feeds being fed.

B=days 5-8 Cows were fed morning and night 10 pounds of a 21% CP pelleted grain mix and turned out to graze with no other feeds being fed.

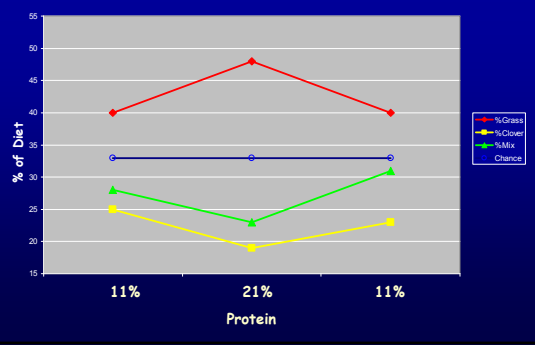
A=days 9-12 Cows were returned to the base diet fed on days 1-4.

Diet selection and foraging locations were recorded every 5 minutes during the first two hours post milking on each of the 12 days a.m. and p.m.

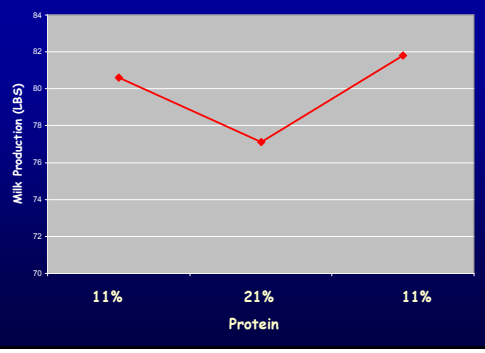
Diet composition by period if selection is by chance



Diet composition by period May 2004 orchardgrass treatment

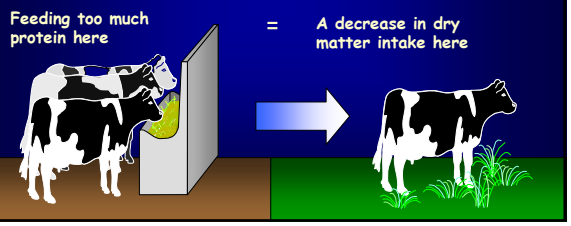


Milk production by period May 2004 orchardgrass treatment



Postingestive feedback is a very rapid process, and it can change what an animal prefers to eat in a matter of minutes.

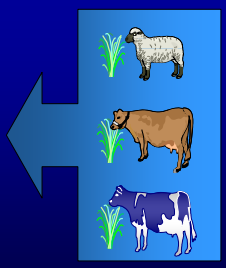
So be careful what you feed in the barn or bunk!



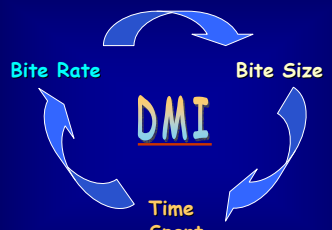
Animal Factors Influencing Dry Matter Intake

Dry Matter Intake

- Kind of animal
- Environmental conditions
- Physiological condition of the animal
- Experience with the food



Dry Matter Intake



Anything that interferes with this process will reduce DMI and thus animal performance

Biting rate/minute

50 – 70 bites per minute is common

93 bites per minute has been observed!

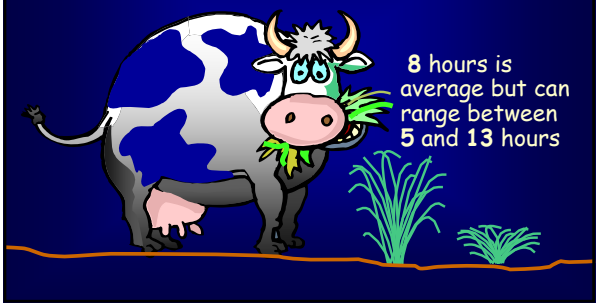
(**28,000 – 35,000** bites per day)

Amount of feed taken/bite

.02 of an ounce per bite or less

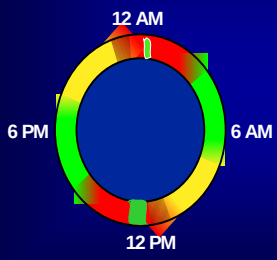
2.0 to **4.0% of** body weight/d in dry matter

Amount of time spent grazing



8 hours is average but can range between **5** and **13** hours

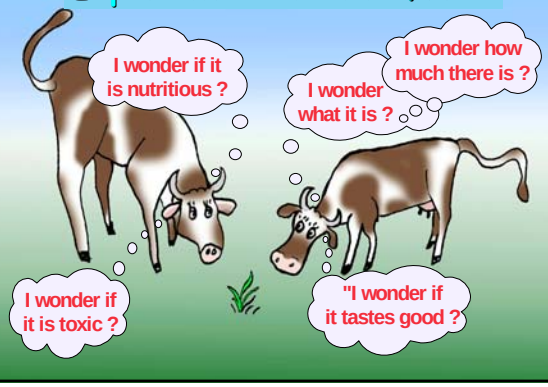
Grazing animal activity periods



GRAZING	= 8 HOURS
RUMINATING	= 8 HOURS
RESTING	= 8 HOURS

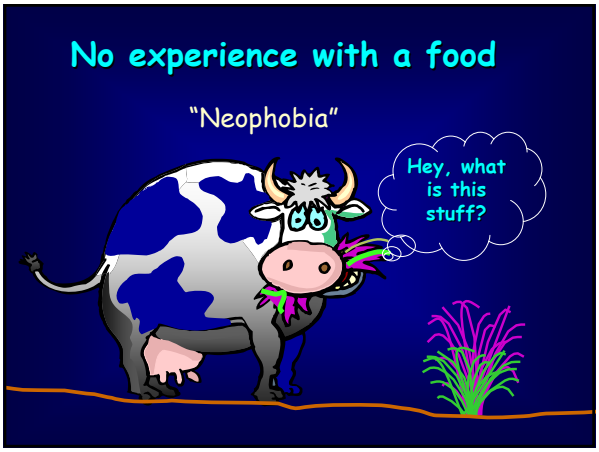
Anything that reduces bite rate, bite size and/or time spent grazing will reduce DMI

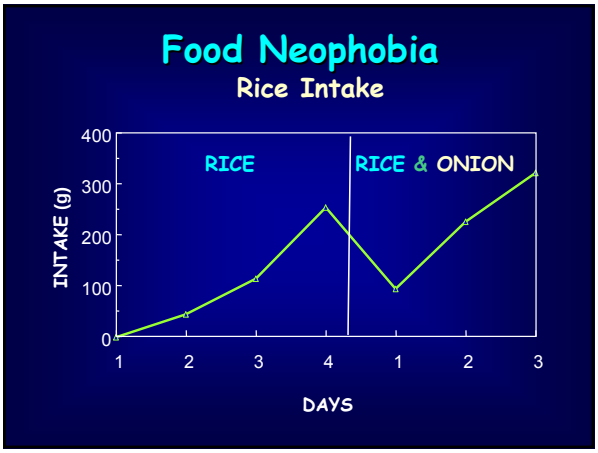
Experience with the food



All Foods Contain Toxins!
Yikes!

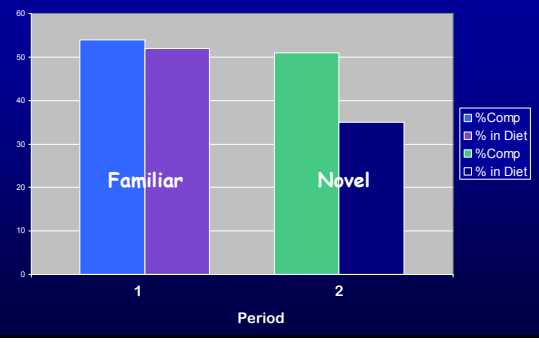
And it is generally not in the best interest of an animal to be the first in the herd or flock to eat the most toxic plant in the pasture!


No experience with a food
"Neophobia"
Hey, what is this stuff?


Food Neophobia
Rice Intake
RICE
RICE & ONION
INTAKE (g)
400
300
200
100
0
1
2
3
4
1
2
3
DAYS

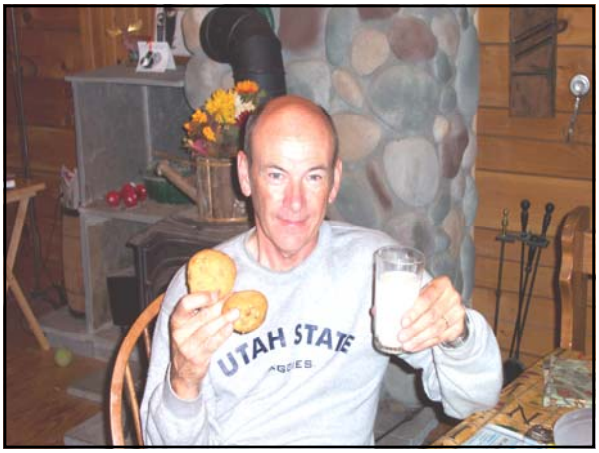
But what about dairy cows on pasture?

Percent Grass in Diet

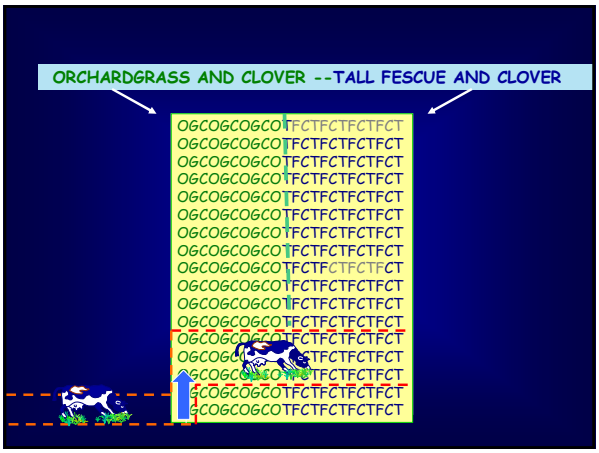


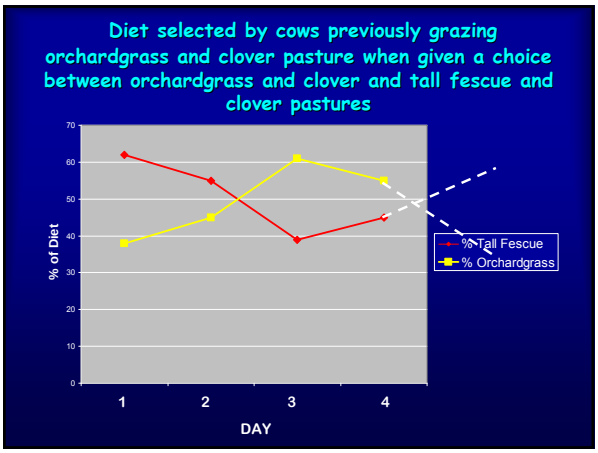
Too much experience with a food

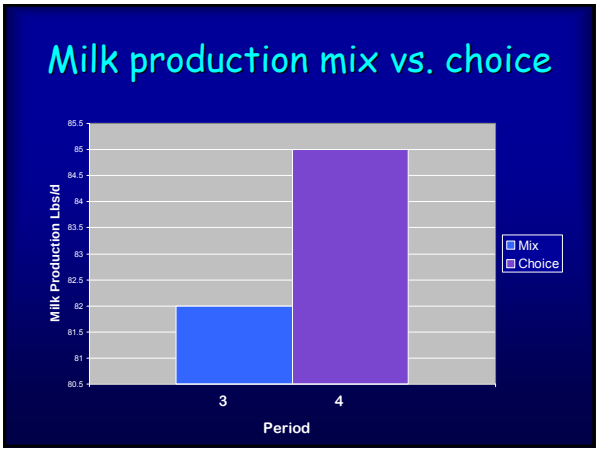
"Transient taste aversion"

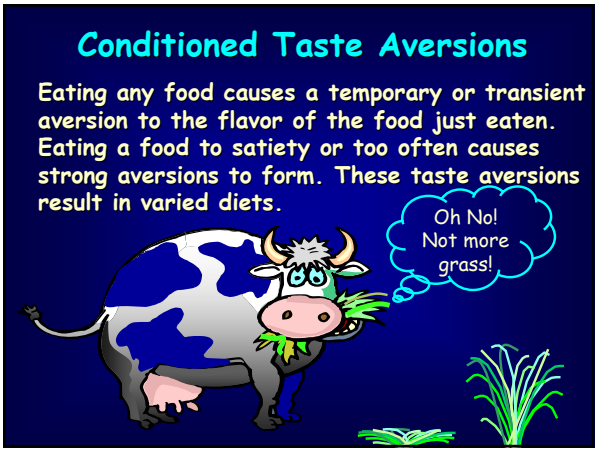


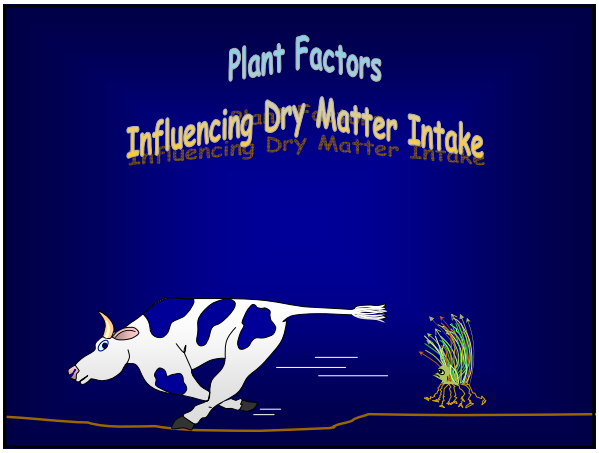
Do cows, like people, get sick of eating the same old thing!


ORCHARDGRASS AND CLOVER --TALL FESCUE AND CLOVER


Diet selected by cows previously grazing orchardgrass and clover pasture when given a choice between orchardgrass and clover and tall fescue and clover pastures
% of Diet
DAY
% Tall Fescue
% Orchardgrass

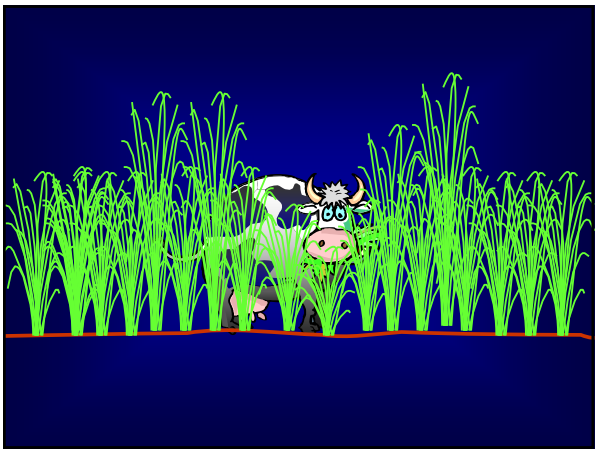

Milk production mix vs. choice
Milk Production Lbs/d
Period
Mix
Choice

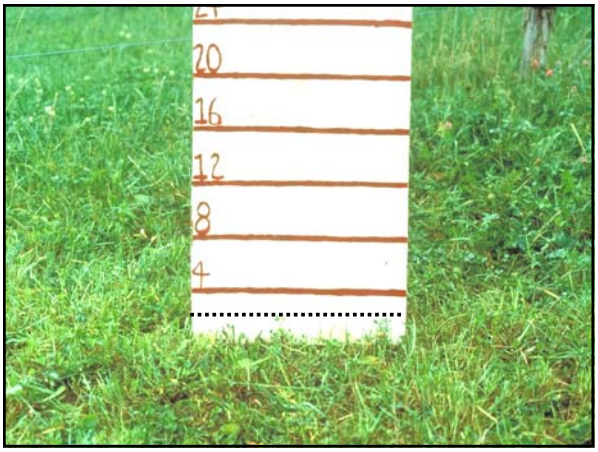

Conditioned Taste Aversions
Eating any food causes a temporary or transient aversion to the flavor of the food just eaten. Eating a food to satiety or too often causes strong aversions to form. These taste aversions result in varied diets.
Oh No! Not more grass!


Plant Factors
Influencing Dry Matter Intake

Forage Quantity

To get the most out of <u>your</u> pasture, <u>you</u> have to get the most pasture into <u>your</u> animals





Forage Quantity

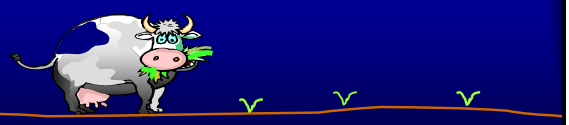
Low yielding pastures (forage height less than 4 inches) cause animals to walk further, graze longer, eat less, and produce less meat, milk, and fiber

Forage Quantity

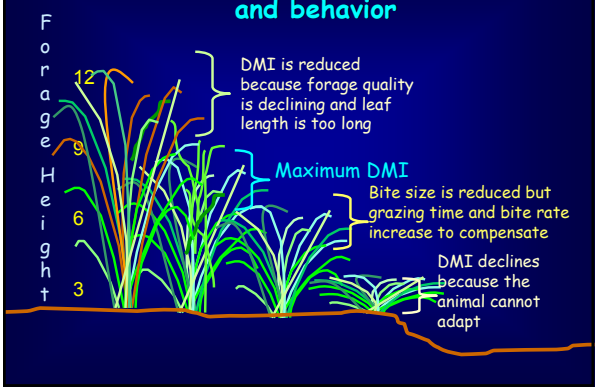
Pastures that are too tall and rank (forage height greater than 10 inches) cause animals to decrease bite rate, take fewer bites, take longer to fill up, and produce less meat, milk, and fiber

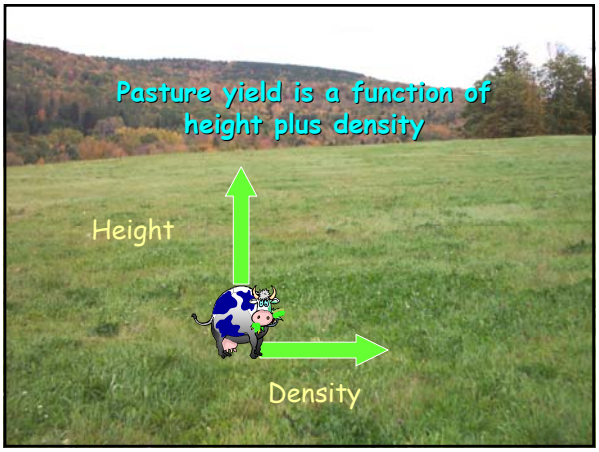
Forage Quantity

And pastures where animals have to walk between bites really miss the point of pasture being a source of food!



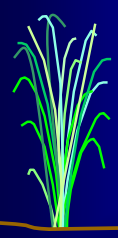
Effect of forage height on DMI and behavior





Forage Quality

Pasture is a high quality food



CP = 14 - 34%

ADF = 20 – 30%

NDF = 33 – 50%

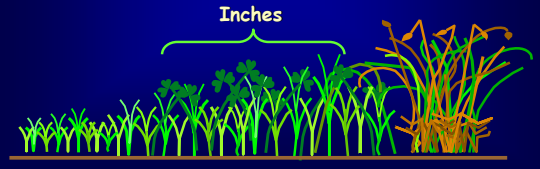
NSC = 9 – 20%

NE_L = .65 - .75 Mcal/lb

The longer a plant grows, the higher the quantity but the lower its quality !

Leafy Vegetative

(6-8 inches tall)

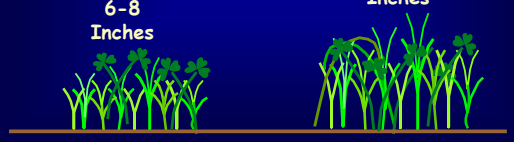


% NDF

Neutral Detergent Fiber

33%
6-8 Inches

50%
10-12 Inches

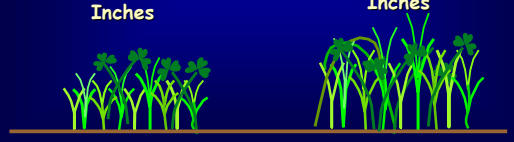


% NDF

DMI as a % of body weight

3.6%
6-8 Inches

2.4%
10-12 Inches

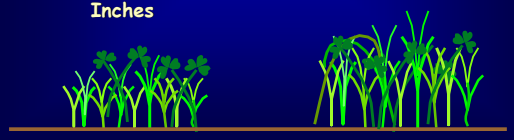


Milk production

1400 lb cow

90-100lbs
6-8 Inches

65-70lbs
10-12 Inches



Forage Toxicity

(Plant Secondary Metabolites)

There is more to a plant than nutrients!

Pasture plants also Ccntain toxins

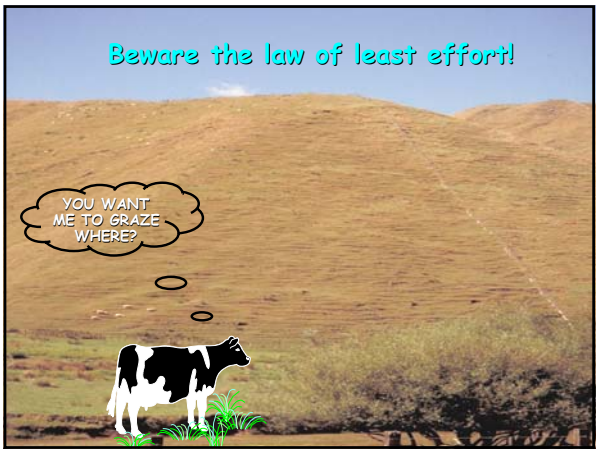
- LEGUMES
  - ALFALFA - CANAVANINE, SAPONIN
  - RED CLOVER - NITRATE
  - ALSIKE CLOVER - NITRATE
  - WHITE CLOVER - NITRATE, CYANOGENIC GLYCOSIDE
  - BFOOT TREFOIL - CN TANNINS
  - SWEET CLOVER - DI COUMAROL
- GRASSES
  - TALL FESCUE - ERGOVALINE
  - P. RYEGRASS - ERGOVALINE
  - R. CANARYGRASS - ALKALOIDS
  - S.VERNAL GRASS - COUMARIN

And the best way for us to ensure that our animals are not getting a toxin over-load or suffer losses in dry matter intake due to taste aversions is to plant pastures with high species diversity.

Behavioral-Based Management Considerations

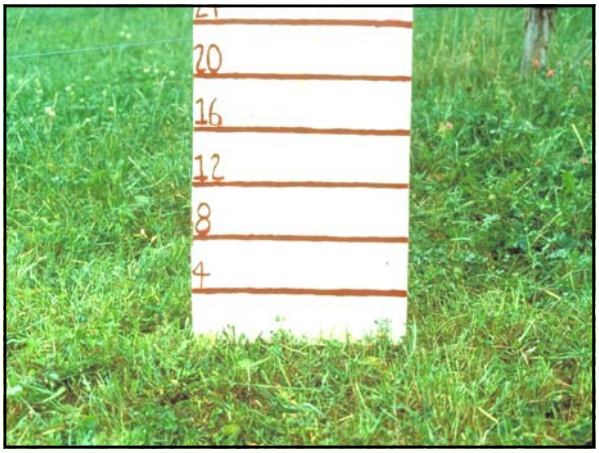
Start grazing young!

Beware the law of least effort!


Beware the law of least effort!
YOU WANT ME TO GRAZE WHERE?

Ensure Pasture Forage Is Of The Proper Quality, Quantity, And Diversity
Legumes, Legumes, Legumes!
Un-supplemented livestock prefer clover 70:30% over grass!

24
20
16
12
8


20
16
12
8
4

APRIL 15 - 96

Food neophobia
Never make your cows guess!
WHAT IS THIS STUFF ANYWAY??

C'MON STOP BEING SUCH A BIG SISSY TAKE A BITE!

Be careful what you feed
in the barn or bunk and….

….don't over-feed PROTEIN!

In the final analysis, if we are looking to optimize the performance and health of our livestock and do so at reduced cost, with the least amount of environmental damage, and with the least amount of stress on both human and animal alike, we must stop dictating to them what they are going to get, and start accommodating what it is they really want and need to live contented healthy lives.