



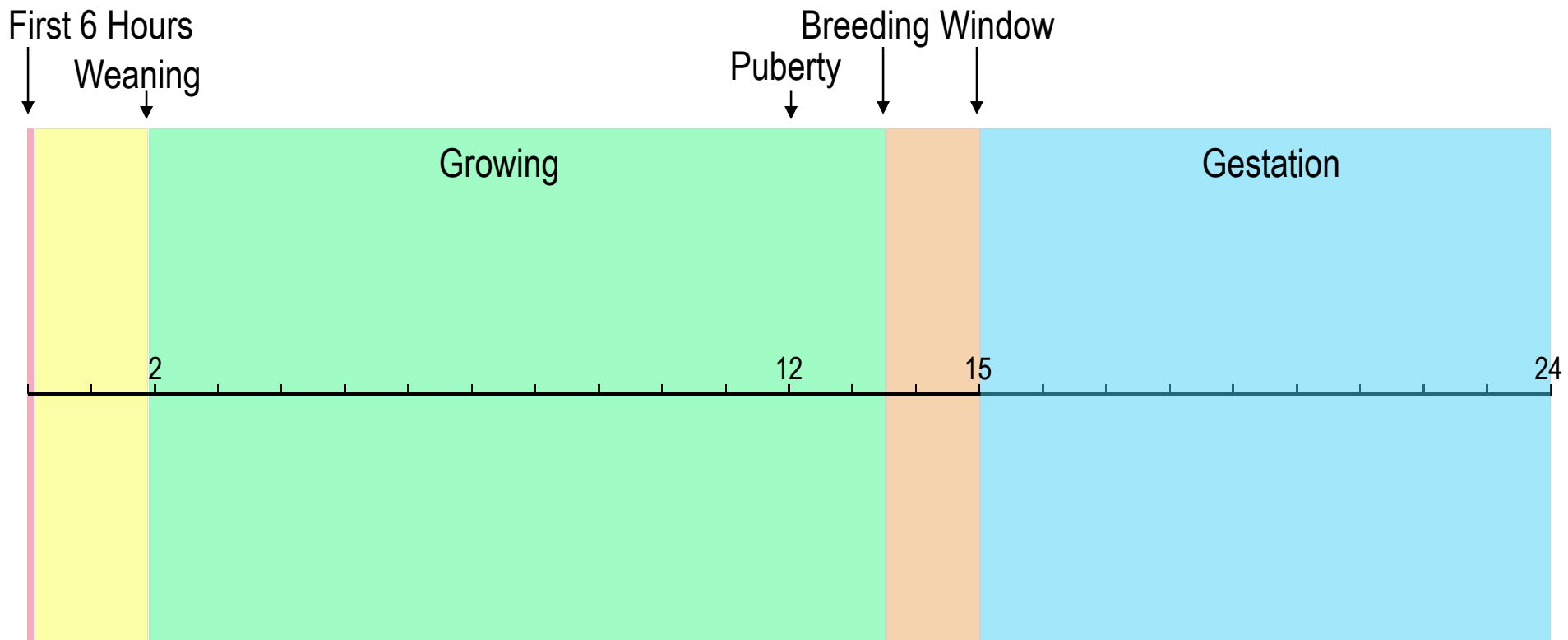
**Internal Herd Growth and Heifer Programs:
Keep Them Alive and Get Them
Pregnant on Time**

**Mike Van Amburgh, Jerry Bertoldo, John
Conway, Tom Overton, Bill Stone and a large cast
of other characters....**

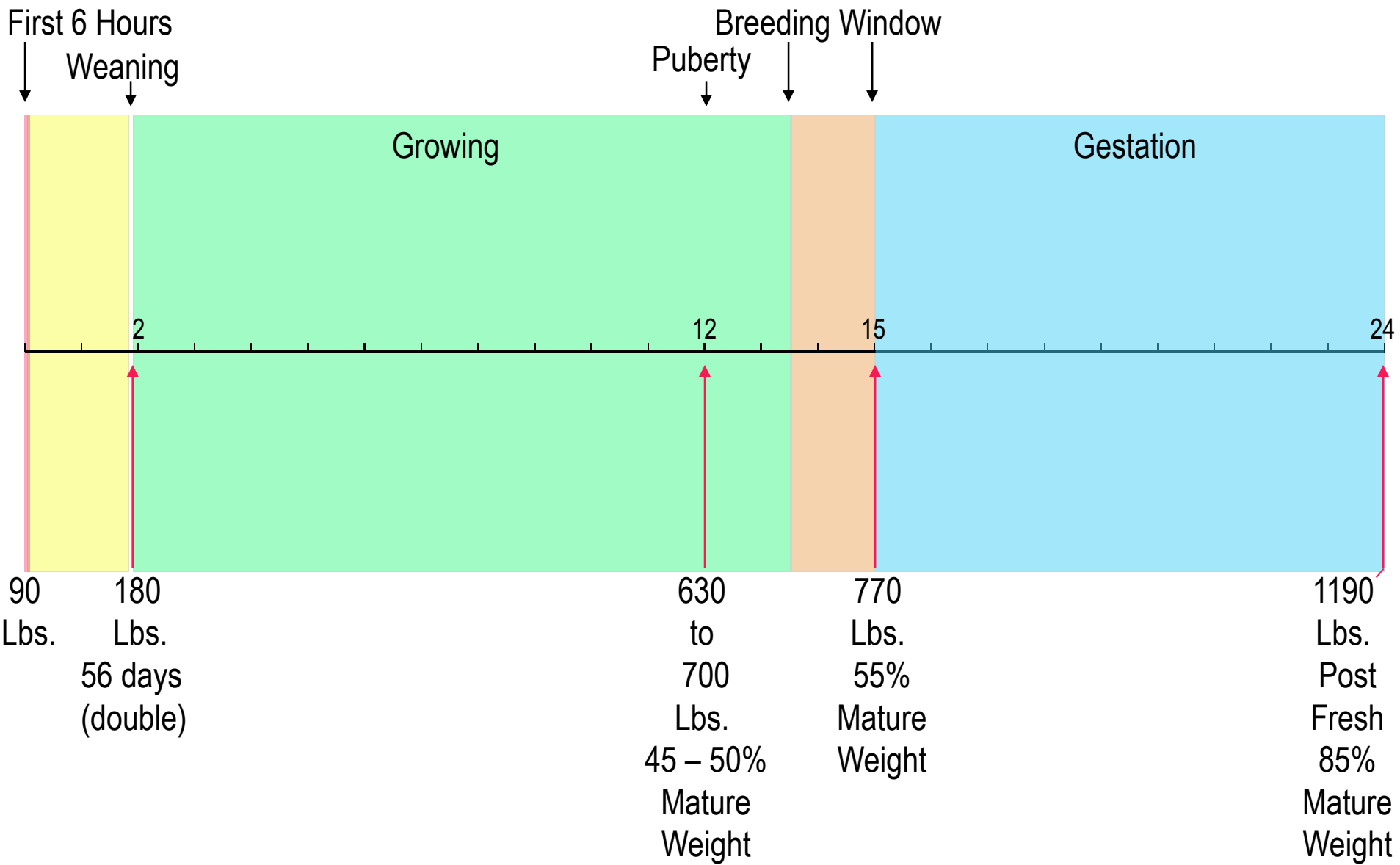
Department of Animal Science

Cornell University

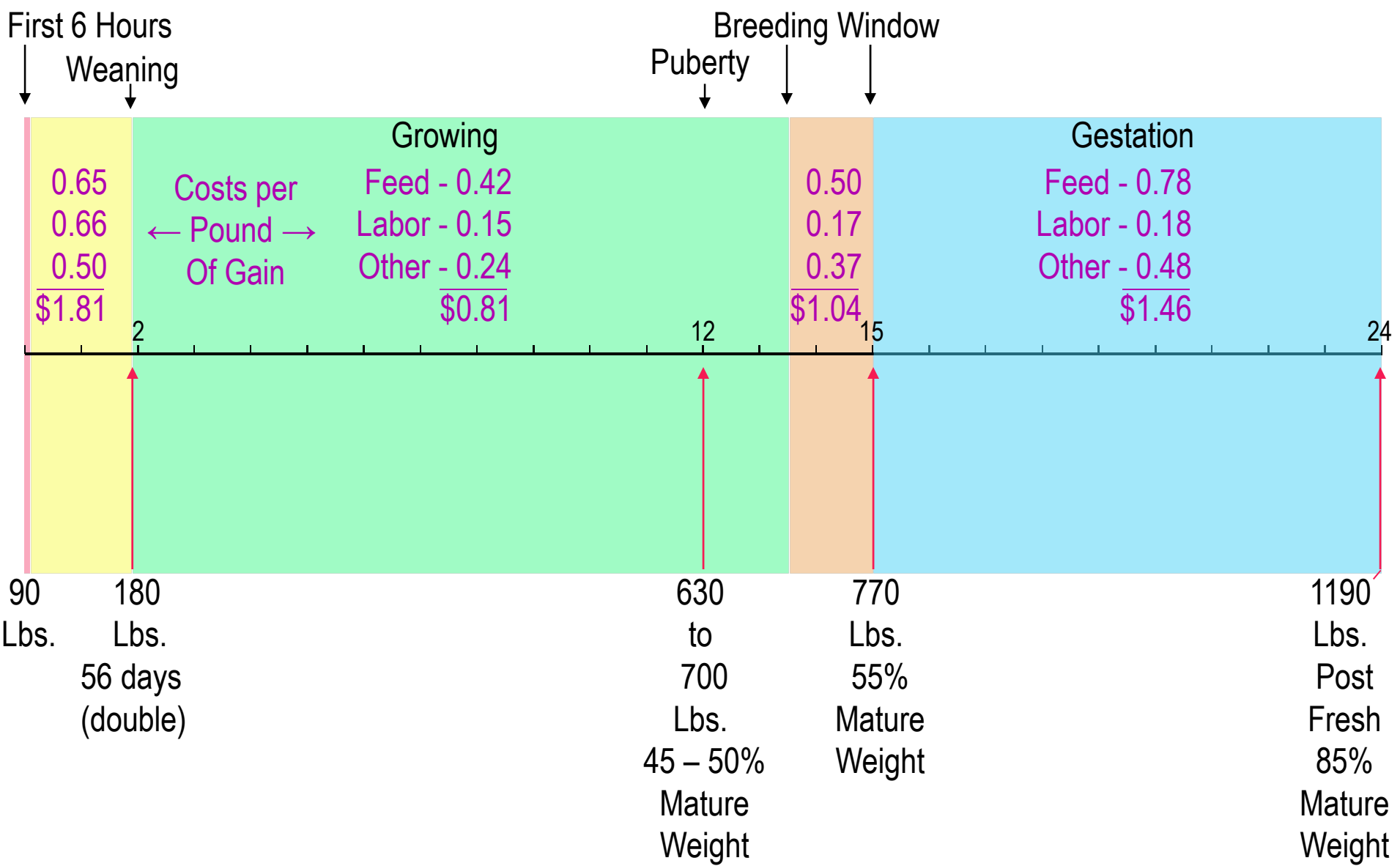
A 24 Month Age at First Calving "Heiferhood" - Mature Weight 1400 Lbs.



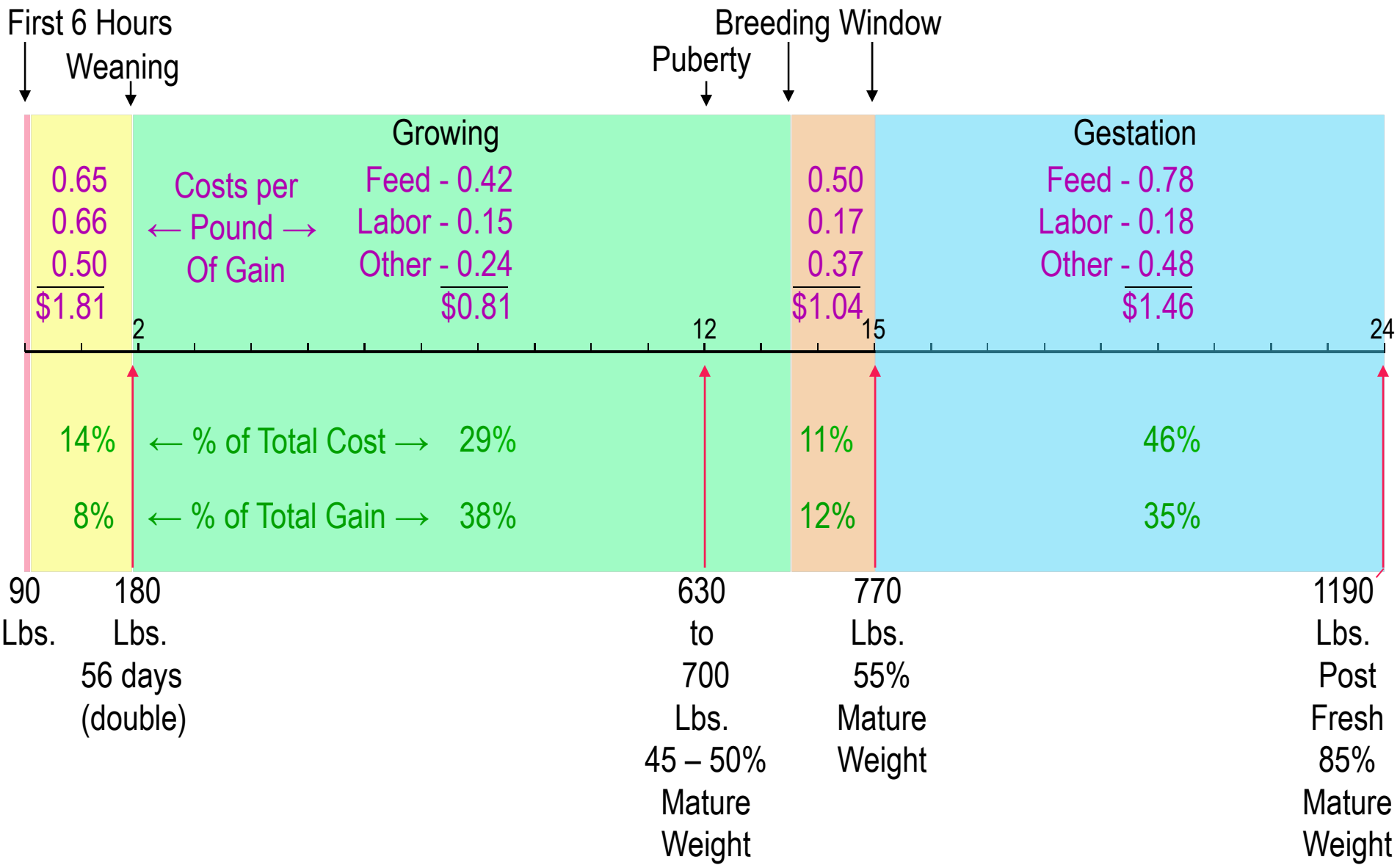
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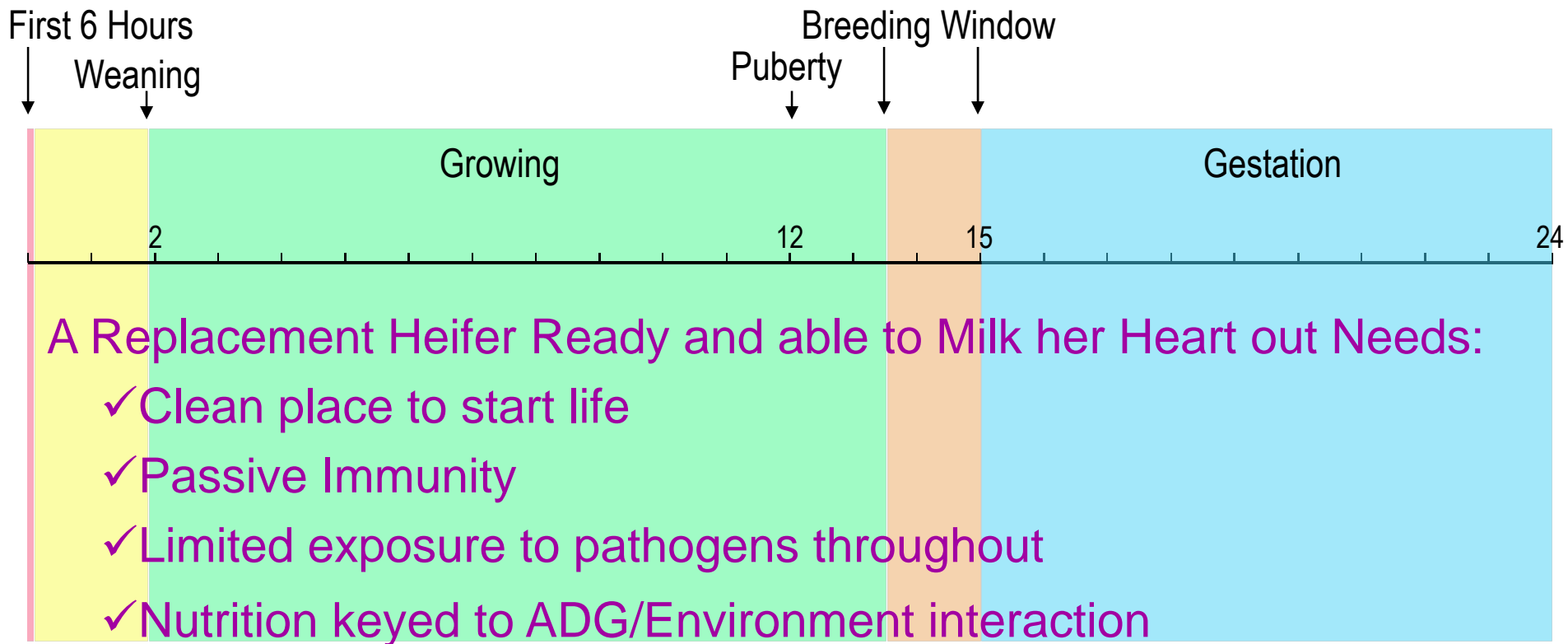
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A 24 Month Age at First Calving "Heiferhood" - Mature Weight 1400 Lbs.



The costs involved in getting her there are depends upon:

- ✓ Interaction of Labor and Environment (Labor Efficiency)
- ✓ Interaction of Nutrition and Environment (Feed Efficiency)
- ✓ Relative costs of inputs, fixed costs, capital













Characteristics of a Sound Calf Program

Calf program growth goal:

Double birth weight by 56 days (~ 180 lb)

Why do this?

Makes it easier to hit breeding weight at an earlier age – reduce AFC – increase potential for IHG, reduce costs.

Starts with the following objectives:

- 1) To equip the calf with adequate antibodies, primarily in the form of colostrum, to fight infections**
- 2) To minimize the calf's exposure to infectious organisms**

Think the 3 Q's of Colostrum Management:

✧ Quality ✧ Quantity ✧ Quickness

Management for Great Colostrum

- **Good dry cow vaccination program**
 - Work with your veterinarian
- **Remove quickly after birth**
 - First milk only; hopefully within 4 to 6 hrs. of parturition
- **Check for specific gravity or Ig content**
- **Clean udder and feeding equipment**
 - Minimize pathogenic bacteria

Colostrum is Richer in Nutrients Than Whole Milk

✧ Quality

	<u>Colostrum (Milking Postpartum)</u>			
	1	2	3	Milk
Total Solids %	23.9	17.9	14.1	12.5
Fat %	6.7	5.4	3.9	3.6
Solids - not - fat %	16.7	12.2	9.8	8.6
Total Protein %	14	8.4	5.1	3.2
Ig %	6	4.2	2.4	0.09
Casein %	4.8	4.3	3.8	2.5
Lactose	2.7	3.9	4.4	4.9
Ash	1.5	N/A	N/A	0.8
Vit. A (ug/100ml)	295	190	113	34
Vit. D (ng/g fat)	30	N/A	N/A	15
Vit. E (ug/g fat)	84	76	76	15

*Adapted from "The Development, Nutrition, and Management of the Young Calf"

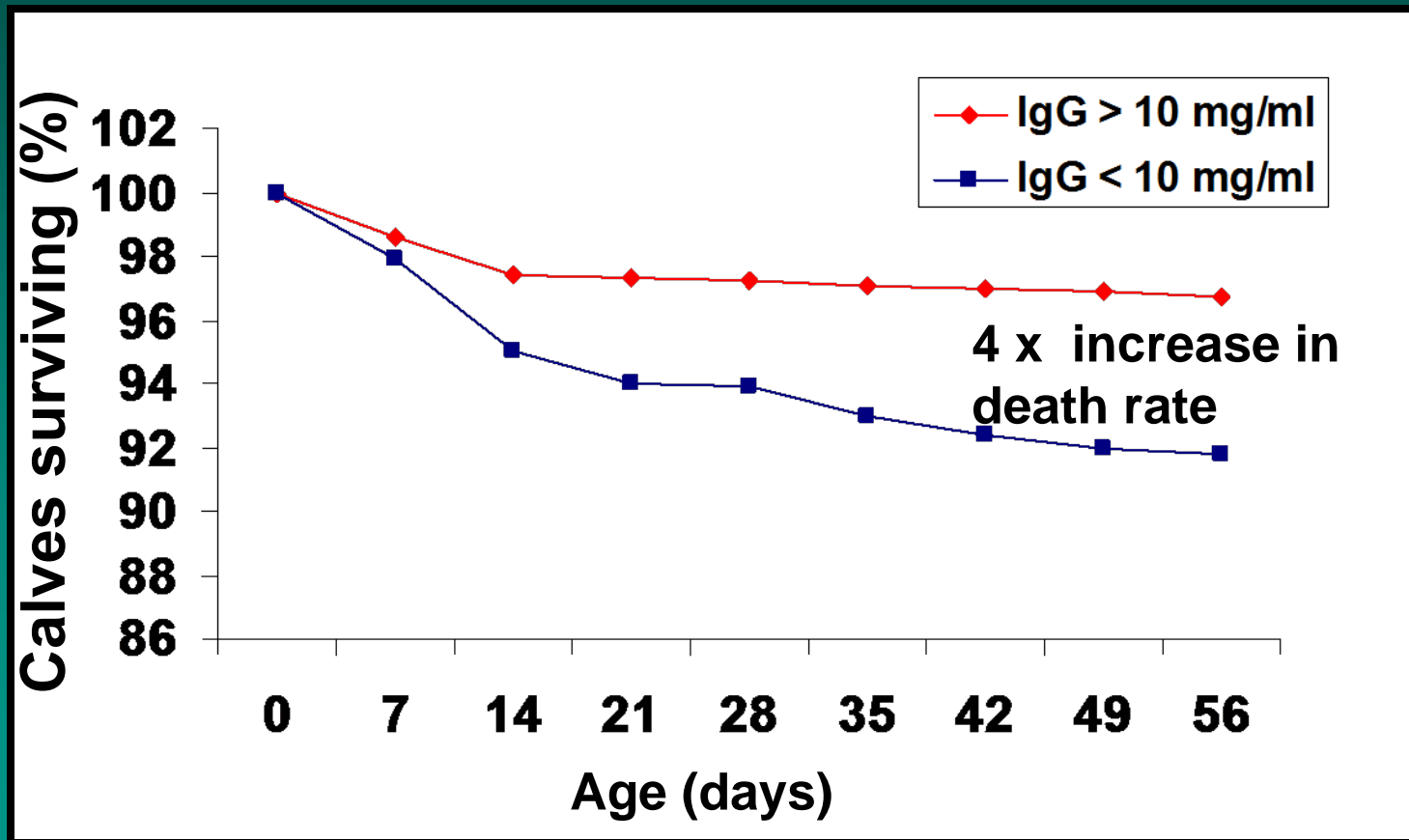
C.L. Davis and J.K. Drackey Iowa State University Press

Passive Transfer Target for Newborn Calf Health

- Want to target **10 mg/ml** in calf serum IgG following colostrum ingestion
- Calves with levels less than **10 mg/ml** have “Failure of Passive Transfer” (FPT)



Failure of Passive Transfer Increases Calf Death Losses



Failure of Passive Transfer Reduces Long Term Performance

- Dairy calves:

- Decreased average daily gain to 180 days (J. Dairy Sci., 1988, 71:1283)

- Decreased milk and fat production at first lactation (J.Dairy Sci., 1989, 72:552)

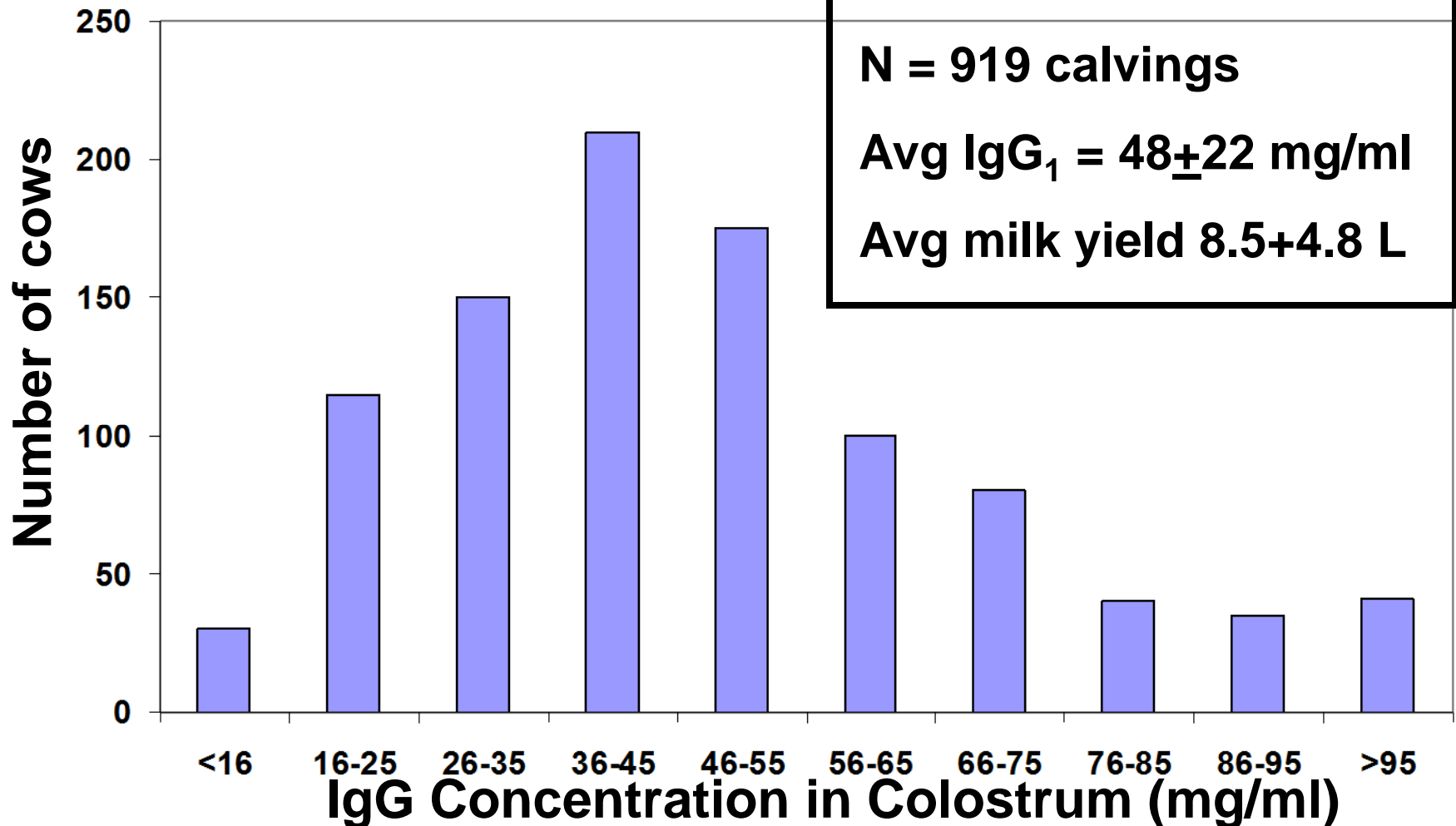
- Delayed time to first calving (Can Vet J., 1986, 50:314)

- Beef Calves:

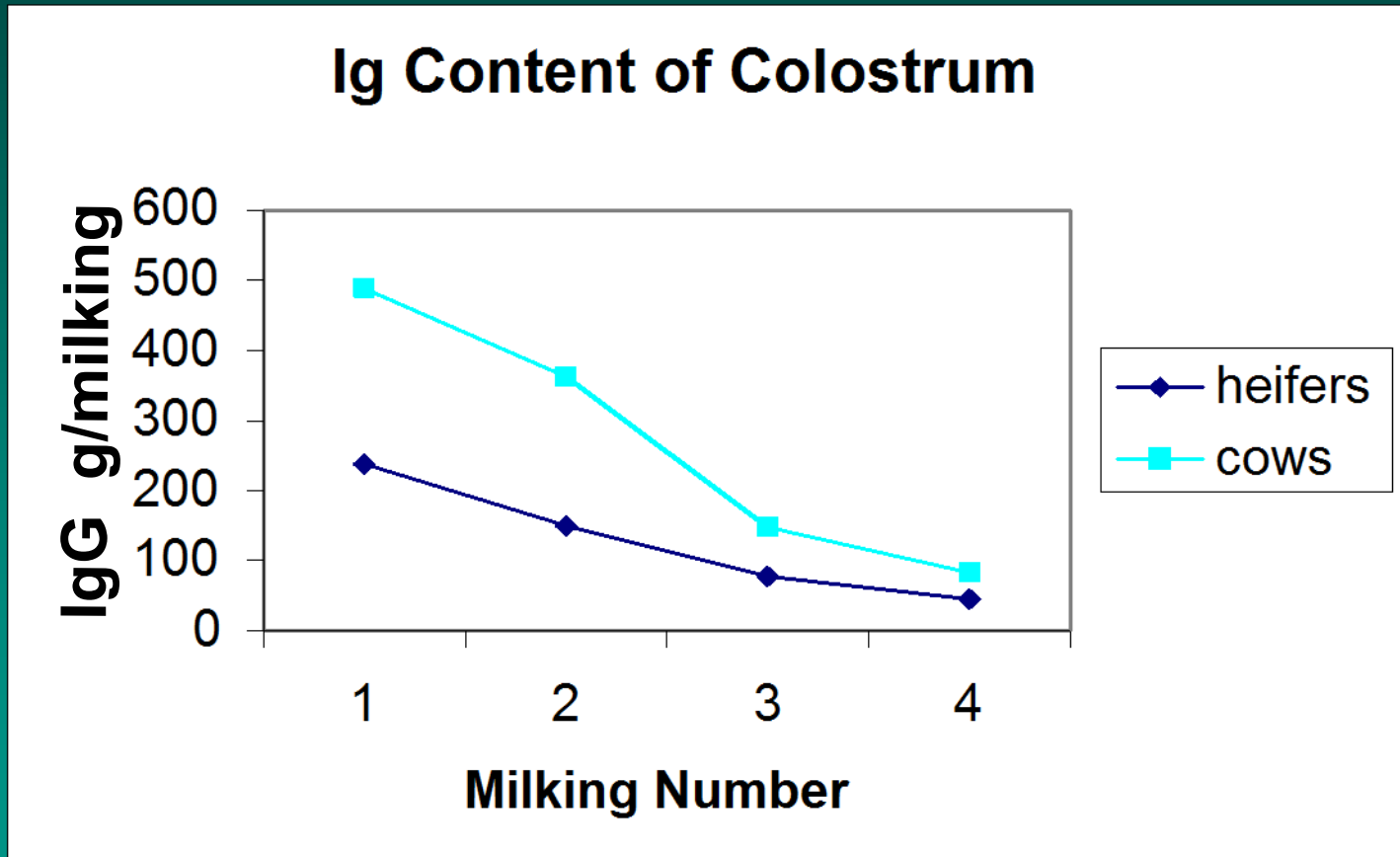
- Higher pre-weaning morbidity and mortality (AABP Proceedings 2002, 35:168)

- Decreased weaning weight at 180 days (Am. J. Vet. Res. 1995, 56:1149)

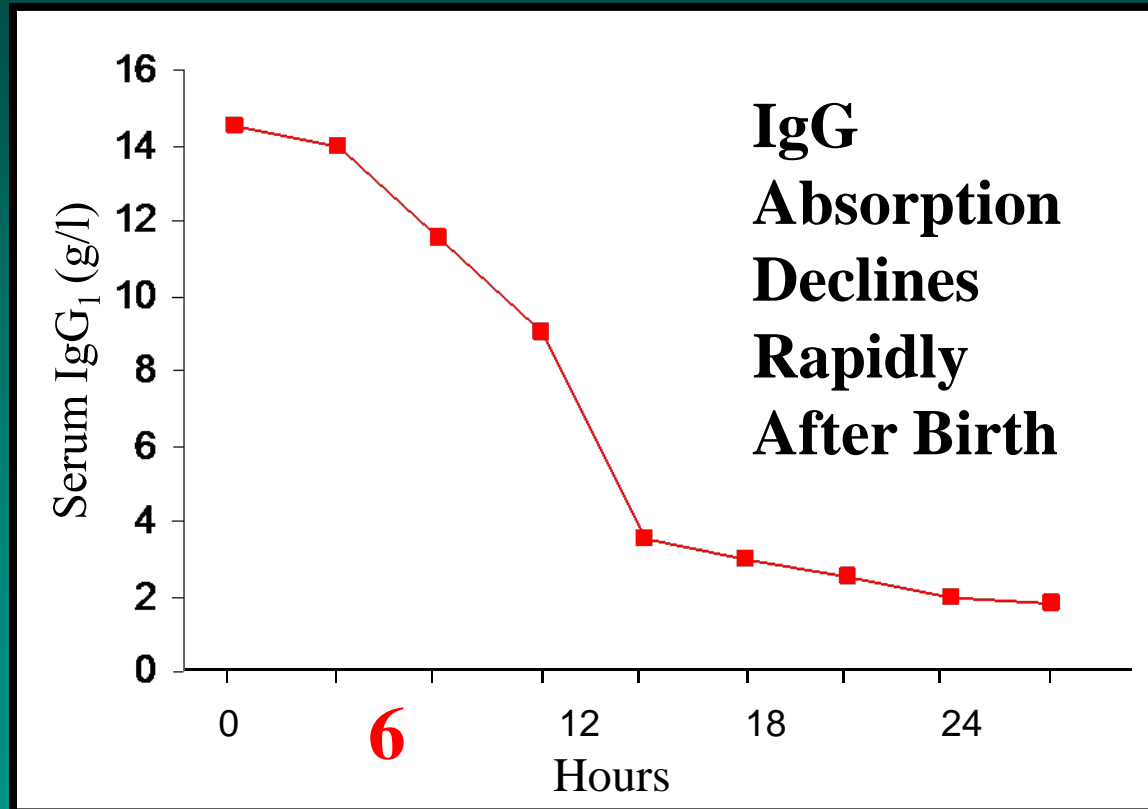
Distribution of IgG₁ in Colostrum from Cows of a Single Dairy



Milking Number and Immunoglobulin Mass in Dairy Cows and Heifers



Age of the Calf at First Colostrum Feeding



****Only calves fed colostrum before 6 hrs had serum IgG levels > 10 mg/ml**

Grams IgG absorbed = volume x concentration

90 lb calf needs 36 grams IgG

Average absorption rate = 35%

Good colostrum = 50g/L

$$50\text{g/L} \times 0.35 \times 2\text{ L} = 35\text{ grams}$$

Fair colostrum = 25g/L

$$25\text{g/L} \times 0.35 \times 4\text{ L} = 35\text{ grams}$$



Fat and Lactose Provide Energy

Calves are born with low energy reserves

- **Fat and lactose are important as immediate sources of energy to maintain body temperature**

Colostrum
1.16 kcal/g

Whole Milk
0.69 kcal/g



From: Davis and Drackley; 1998

**Comparison of Calf Performance,
Morbidity and Mortality of
Purchased Holstein Calves
Based Upon Immunoglobulin
Status**

Four Week Calf Performance and Health by Calves (2,016 Calves) in Each Relative Immunoglobulin Status Group

	Serum Ig mg/ml				
	<u>0-4.9</u>	<u>5.0-9.9</u>	<u>10-14.9</u>	<u>15-24.9</u>	<u>25+</u>
Number of Calves	129	224	323	592	748
Percent of Total Calves	6.4	11.1	16.0	29.4	37.1
4-Week Calf Weight Gain, Lbs.	21.05 ^c	23.58 ^b	24.12 ^{ab}	24.53 ^{ab}	25.41 ^a
Feed Conversion, Lbs. feed/Lb. gain	2.70 ^a	2.15 ^b	2.16 ^b	1.96 ^b	1.85 ^b
Average Fecal Score	1.38 ^a	1.28 ^b	1.24 ^c	1.25 ^{bc}	1.24 ^c
Scour Days	7.31 ^a	5.66 ^b	4.76 ^c	5.07 ^{bc}	4.86 ^c
Mortality, %	29 ^c	16 ^b	11 ^a	8 ^a	8 ^a
a,b,c (P<.05)					

Data from Land O'Lakes Research Farm

Time Calves Remain With Cows After Birth and Heifer Calf Mortality

Time (Hours)	No. Herds	Average Mortality (%) (Calves 1 Week-6 Months of Age)
2- 6	13	5.2
7-12	35	9.3
13-24	32	10.7
25-48	24	20.5
+48	35	14.4

* Clemson University

Objectives of Calf Management from After Colostrum to Weaning

- To meet the calf's nutrient requirements for maintenance and growth with milk or milk replacer.
- To stimulate appetite, begin rumen development, and meet the calf's nutrient requirements for growth with a high quality calf starter and water.
- To prevent scours which can cause dehydration, diminish growth rates and possibly cause death.

Environmental and Stress Effects on Maintenance Requirements

The thermoneutral zone for young lightweight calves is in the range of 15 to 28°C (Gonzalez-Jimenez and Blaxter, 1962; Scibilia et al., 1987; Shrama et al., 1992, 1993; Arieli et al., 1995)

The additional heat increment required to maintain core body temperature below 15 °C (59 °F) is approximately $0.022 \text{ Mcal/kg}^{0.75}/^{\circ}\text{C}$, especially for calves $< 21 \text{ d}$.

For calves > 21 days of age the LCT is $\sim 5 \text{ }^{\circ}\text{C}$ (42 °F).

Amount of Milk or Milk Replacer Needed to Meet Maintenance Requirements

Temp. °F	59 ^a	32	5
Body weight, lb	Lb milk or milk replacer/d		
110 (MR)	1.00	1.35	1.77
110 (milk)	0.91 (7.3)	1.20 (9.6)	1.51 (12.1)

^aLower critical temp. calves less than 21 d age.

Environmental and Stress Effects on Maintenance Requirements

Based on Arieli et al. (1995) an additional adjustment of $0.03 \text{ Mcal ME/kg}^{0.75}$ might be warranted for wet calves that have been transported or are adapting to other stressors for at least 14 days after the initial stress.

Stress can be defined as transportation, significant alteration in temperature or a social and dietary change

Equivalent to 0.5 to 0.6 Mcal ME/d for the average calf (~ 0.12 kg of DM/d (0.25 lb DM/d))

Updated Nutrient Requirements of a 110 lb Calf Under Thermoneutral Conditions

Rate of gain, lb/d	ME ^a , mcal/d	DMI, kg/d	ADP, g/d	CP, g/d	CP, % DM
0.44	2.35	0.51	87	94	18.5
0.88	2.89	0.67	140	150	22.3
1.32	3.48	0.77	193	207	26.0
1.76	4.13	0.95	235	253	26.8
2.20	4.80	1.15	286	307	27.5

^a0.6 efficiency of use of ME and 0.72 for BV of protein

Just what are we “Replacing”!

Holstein Milk (on Average)

	As Fed Basis	Dry Matter Basis
% Butterfat	3.6	28.8
% Crude Protein	3.2	25.6
% Lactose	4.9	39.2
% Ash	0.8	6.4
% Total Solids	12.5	100

Calf program growth goal:

Double birth weight by 56 days (~ 180 lb)

Why do this?

Makes it easier to hit breeding weight at an earlier age – reduce AFC – increase potential for IHG, reduce costs.



















Target Growth Rates – Integrates Management and Biology

Approach determined by: Mature body weight (3rd and greater parity cattle – not cull cows)

Concept of physiologic maturity - puberty occurs at a given percentage of mature size (45% to 50%)

Pregnancy should occur by 55% mature body weight

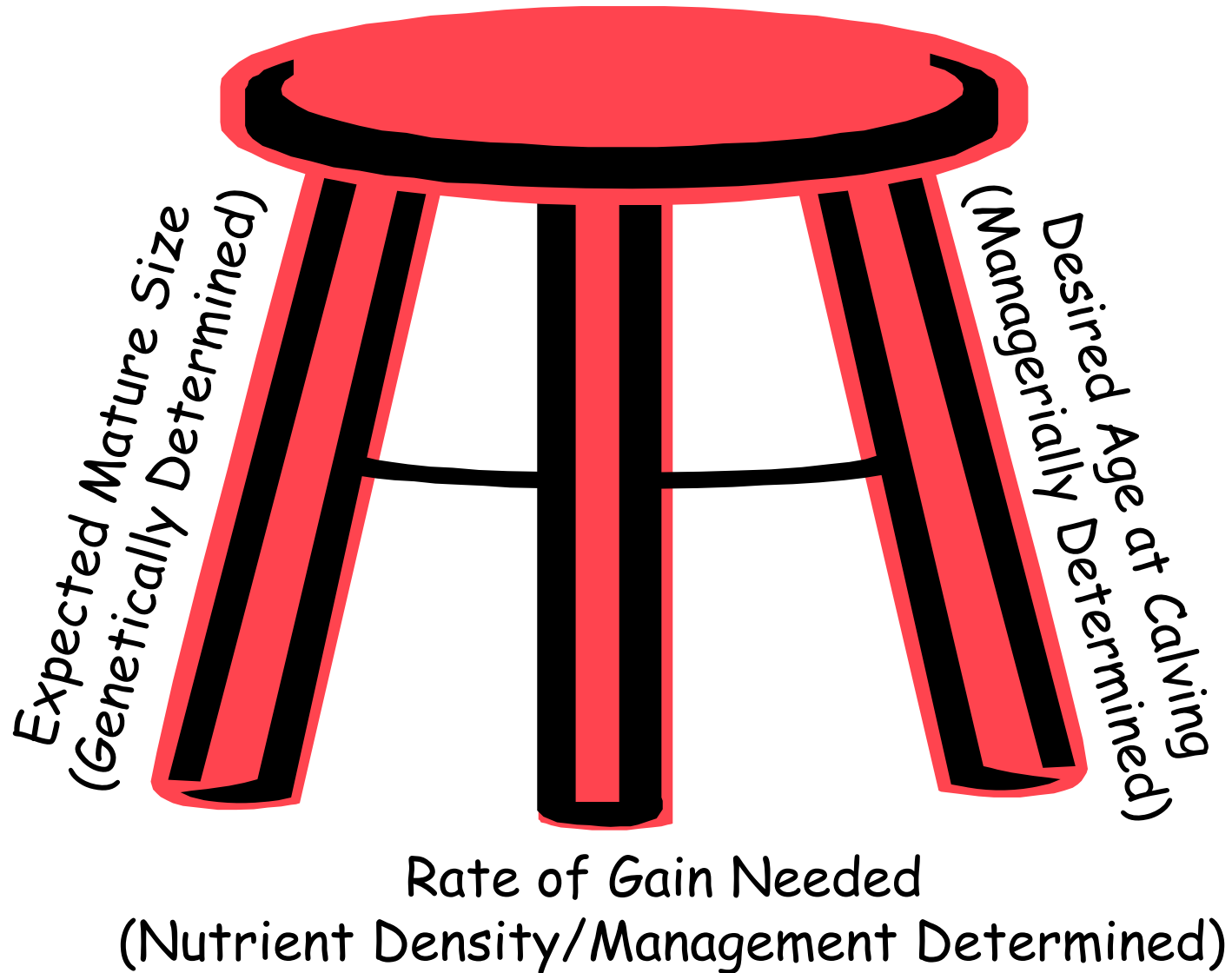
Herd goals for age at first calving

"My Canadian Wonders"

- ☞ Dave Lundgren, Dairy Producer, Prairie Du Sac, Wisconsin
- ☞ 1984
- ☞ Among the first to put full TMR into Tie-stall Barn
- ☞ High "PD" American Sire Heifers performed very well
- ☞ "Canadian Wonders" (herdmates) lagged behind as heifers
- ☞ By 3rd Lactation "Canadian Wonders" equaled/out performed
- ☞ Raised together, grouped by age, freshened at 24 months
- ☞ "Americans" were 85% of Mature Size - 1200 lbs. post-fresh
- ☞ "Canadians" were 75% of Mature Size - 1200 lbs. post-fresh
- ☞ "Americans" going to 1400 lbs., "Canadians" to 1600 lbs.

Heifers raised in group pens. What were his options?

Amazingly, yet another, 3 - legged stool!



**24
Month
Freshening**

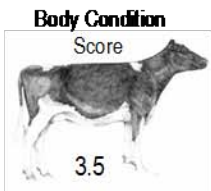
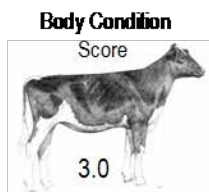
Average Daily Gains by Mature Weights for 24 Month Freshening

	Mature Bodyweight in Pounds										
	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Birth → Pregnancy	0.95	1.06	1.17	1.28	1.38	1.49	1.6	1.71	1.81	1.92	2.03
Pregnancy → Calving	0.99	1.1	1.21	1.32	1.43	1.54	1.64	1.75	1.86	1.97	2.08
Last Trimester Pregnancy	2.44	2.55	2.66	2.77	2.88	2.99	3.09	3.2	3.31	3.42	3.53

Monthly Target Weights for 24 Month Freshening

		Mature Body Weights										
		900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Age in Months	Birth	60	66	72	78	84	90	96	102	108	114	120
	1	89	99	108	117	127	136	145	155	164	173	183
	2	119	131	144	157	169	182	195	207	220	232	245
	3	148	164	180	196	212	228	244	260	276	292	308
	4	178	197	216	235	255	274	293	312	332	351	370
	5	207	230	252	275	297	320	342	365	388	410	433
	6	236	262	288	314	340	366	392	418	444	469	495
	7	266	295	324	353	383	412	441	470	499	529	558
	8	295	328	360	393	425	458	490	523	555	588	620
	9	325	361	396	432	468	504	540	575	611	647	683
	10	354	393	432	472	511	550	589	628	667	706	745
	11	384	426	468	511	553	596	638	681	723	766	808
	12	413	459	504	550	596	642	688	733	779	825	871
	13	442	491	541	590	639	688	737	786	835	884	933
	14	472	524	577	629	681	734	786	838	891	943	996
	15	495	550	605	660	715	770	825	880	935	990	1045
	16	525	583	642	700	758	817	875	933	992	1050	1108
	17	555	617	678	740	802	863	925	987	1048	1110	1172
	18	585	650	715	780	845	910	975	1040	1105	1170	1235
	19	615	683	752	820	888	957	1025	1093	1162	1230	1298
	20	645	717	788	860	932	1003	1075	1147	1218	1290	1362
	21	719	794	869	944	1019	1094	1169	1244	1319	1394	1469
	22	794	872	950	1029	1107	1185	1264	1342	1420	1499	1577
	23	868	950	1031	1113	1195	1276	1358	1440	1521	1603	1685
24	765	850	935	1020	1105	1190	1275	1360	1445	1530	1615	

Body Weights Must Always be Taken in Conjunction with either Body Scores or Hip Heights



Illustrations by Barb Spike. Courtesy of Elanco Animal Health



Average Daily Gains by Mature Weights for 24 Month Freshening

Birth → Pregnancy
Pregnancy → Calving
Last Trimester Pregnancy

		Mature Bodyweight in Pounds										
		900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Birth → Pregnancy	0.95	1.06	1.17	1.28	1.38	1.49	1.6	1.71	1.81	1.92	2.03	
Pregnancy → Calving	0.99	1.1	1.21	1.32	1.43	1.54	1.64	1.75	1.86	1.97	2.08	
Last Trimester Pregnancy	2.44	2.55	2.66	2.77	2.88	2.99	3.09	3.2	3.31	3.42	3.53	

Monthly Target Weights for 24 Month Freshening

Conjunction
weights

condition



condition



imal Health

		Mature Body Weights										
		900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Age in Months	Birth	60	66	72	78	84	90	96	102	108	114	120
	1	89	99	108	117	127	136	145	155	164	173	183
	2	119	131	144	157	169	182	195	207	220	232	245
	3	148	164	180	196	212	228	244	260	276	292	308
	4	178	197	216	235	255	274	293	312	332	351	370
	5	207	230	252	275	297	320	342	365	388	410	433
	6	236	262	288	314	340	366	392	418	444	469	495
	7	266	295	324	353	383	412	441	470	499	529	558
	8	295	328	360	393	425	458	490	523	555	588	620
	9	325	361	396	432	468	504	540	575	611	647	683
	10	354	393	432	472	511	550	589	628	667	706	745
	11	384	426	468	511	553	596	638	681	723	766	808
	12	413	459	504	550	596	642	688	733	779	825	871
	13	442	491	541	590	639	688	737	786	835	884	933
	14	472	524	577	629	681	734	786	838	891	943	996
	15	495	550	605	660	715	770	825	880	935	990	1045
	16	525	583	642	700	758	817	875	933	992	1050	1108
	17	555	617	678	740	802	863	925	987	1048	1110	1172
	18	585	650	715	780	845	910	975	1040	1105	1170	1235
	19	615	683	752	820	888	957	1025	1093	1162	1230	1298
	20	645	717	788	860	932	1003	1075	1147	1218	1290	1362
	21	719	794	869	944	1019	1094	1169	1244	1319	1394	1469
	22	794	872	950	1029	1107	1185	1264	1342	1420	1499	1577
	23	868	950	1031	1113	1195	1276	1358	1440	1521	1603	1685
24	765	850	935	1020	1105	1190	1275	1360	1445	1530	1615	



Average Daily Gains by Mature Weights for 22 Month Freshening

Mature Bodyweight in Pounds

Birth → Pregnancy
Pregnancy → Calving
Last Trimester Pregnancy

	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Birth → Pregnancy	1.11	1.22	1.35	1.47	1.6	1.72	1.84	1.97	2.09	2.22	2.54
Pregnancy → Calving	0.99	1.1	1.21	1.32	1.43	1.54	1.64	1.75	1.86	1.97	2.08
Last Trimester Pregnancy	2.44	2.55	2.66	2.77	2.88	2.99	3.09	3.2	3.31	3.42	3.53

Monthly Target Weights for 22 Month Freshening

Mature Body Weights

		900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
Age in Months	Birth	60	66	72	78	84	90	96	102	108	114	120
	1	94	104	114	124	133	143	153	163	173	182	192
	2	128	142	155	169	183	196	210	224	237	251	265
	3	162	180	197	215	232	250	267	284	302	319	337
	4	196	217	239	260	281	303	324	345	367	388	409
	5	230	255	280	306	331	356	381	406	431	456	482
	6	264	293	322	351	380	409	438	467	496	525	554
	7	298	331	364	397	429	462	495	528	561	593	626
	8	332	369	405	442	479	515	552	589	625	662	699
	9	366	407	447	488	528	569	609	649	690	730	771
	10	400	444	489	533	577	622	666	710	755	799	843
	11	434	482	530	579	627	675	723	771	819	867	916
	12	468	520	572	624	676	728	780	832	884	936	988
	13	495	550	605	660	715	770	825	880	935	990	1045
	14	525	583	642	700	758	817	875	933	992	1050	1108
	15	555	617	678	740	802	863	925	987	1048	1110	1172
	16	585	650	715	780	845	910	975	1040	1105	1170	1235
	17	615	683	752	820	888	957	1025	1093	1162	1230	1298
	18	645	717	788	860	932	1003	1075	1147	1218	1290	1362
	19	719	794	869	944	1019	1094	1169	1244	1319	1394	1469
	20	794	872	950	1029	1107	1185	1264	1342	1420	1499	1577
	21	868	950	1031	1113	1195	1276	1358	1440	1521	1603	1685
	22	765	850	935	1020	1105	1190	1275	1360	1445	1530	1615

Conjunction
ights

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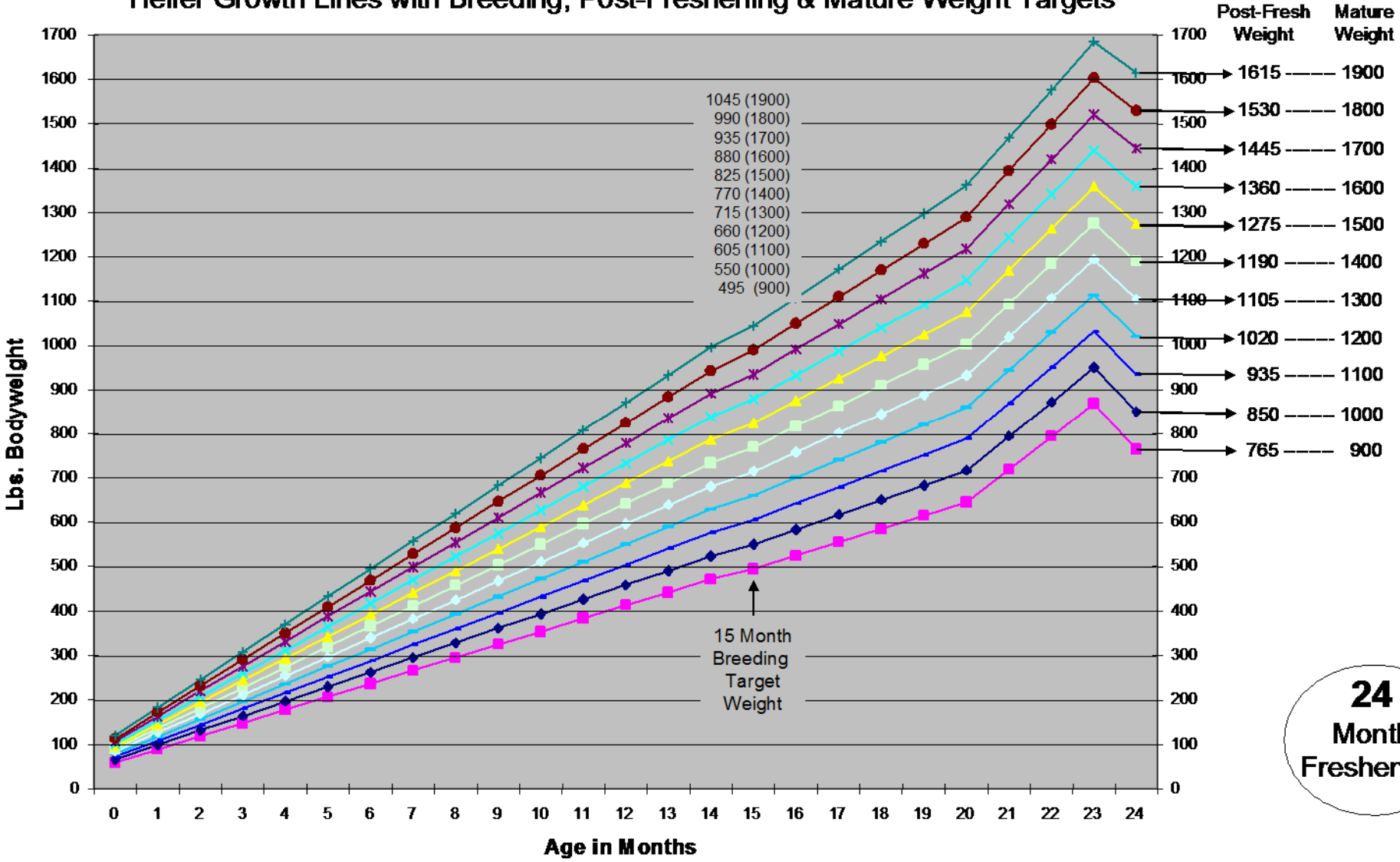


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nal Health

Heifer Growth Lines with Breeding, Post-Freshening & Mature Weight Targets



**24
Month
Freshening**

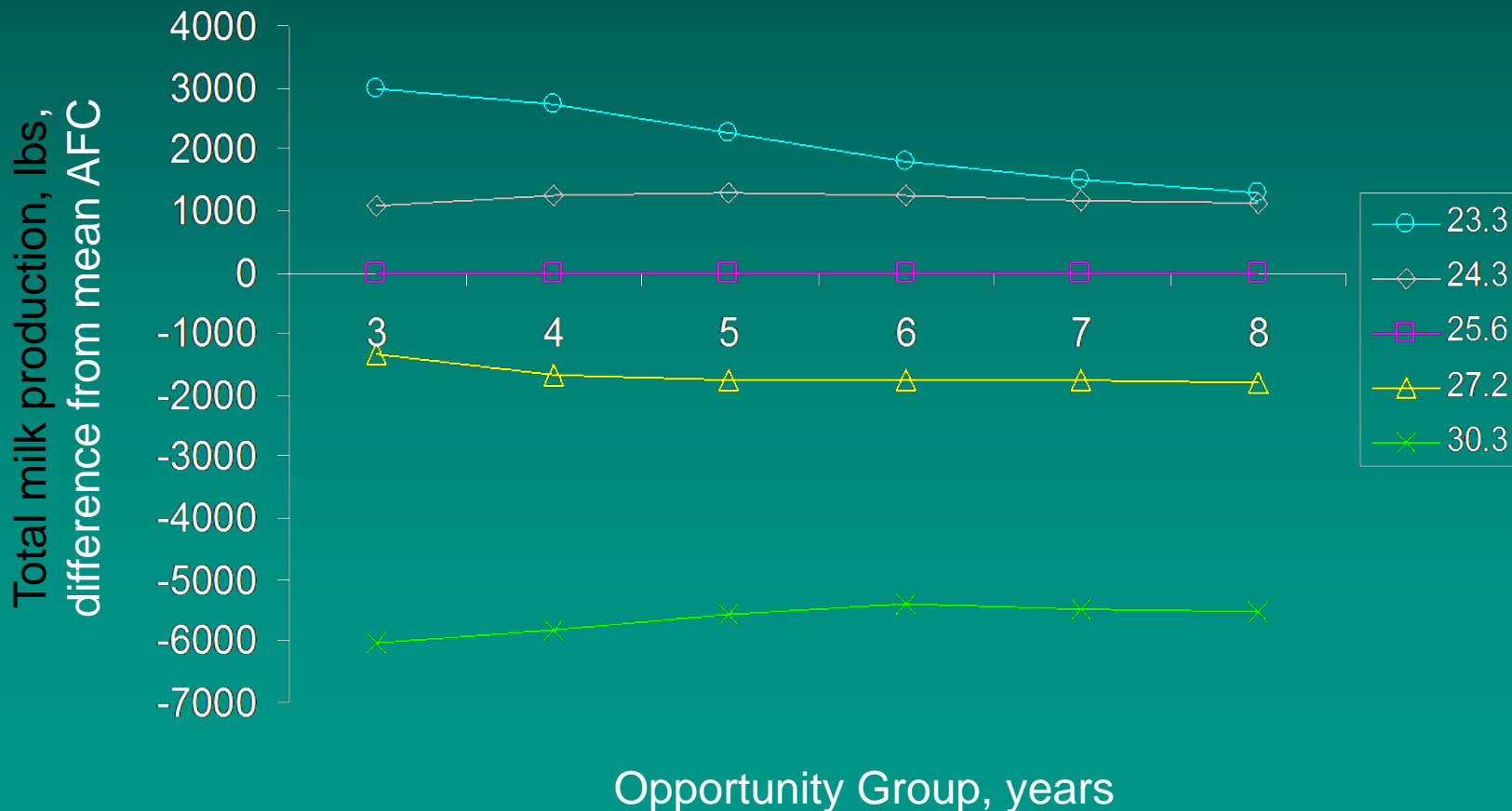
Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Figure 1. Average number of productive days, difference from herd mean AFC (25.6 month)



Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Figure 2. Average total milk production, lbs, difference from herd mean AFC (25.6 month)



Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Figure 3. Average stayability, % survival, difference from herd mean AFC (25.6 month)



Conclusions

- 1) Reducing AFC to ~22 months is likely to result in a ~5% reduction in first lactation milk yield; later lactations are not affected.
- 2) Cow health and stayability is not affected by reduced AFC if she calves in at adequate BW, stature.
 - Conceive @ 55% mature BW, 47" wither height;
 - Post calving BW = 82% of MBW, 54" wither height
- 3) Lifetime productive days and milk is greater for cows with lower AFC.
- 4) Economic analysis indicates that lower AFC is slightly more advantageous.
- 5) Lower AFC provides an increased availability of heifers for replacements.