

Optimizing Detection Dog Performance: Addressing the Factors of Psychology, Metabolism and Structure

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Applying Sports Medicine Concepts to Canine Work Activities

- Detection Work
- Acknowledging the Psychological Effectors
- Addressing Psychological Stressors
- Metabolic Conditioning
- Prevent Injury and Structural Breakdown



The Optimal Hunt or Search

Applying Science to Optimize Activity

- Two parts
 - Environmental Searching Conditions
 - Detection Abilities of the Dog



If we have an off day we tend to blame the conditions when sometimes it could be the dogs

Rule of Three

- One “off” day could just be an off-day
- Two consecutive “off” days, may want to monitor dog
- Three or more “off” days, the dog should be evaluated to confirm metabolic or structural factors are not involved

Optimizing Canine Performance

Factors that Affect Performance

Internal Factors

- Anatomical
- Physiological
- Psychological

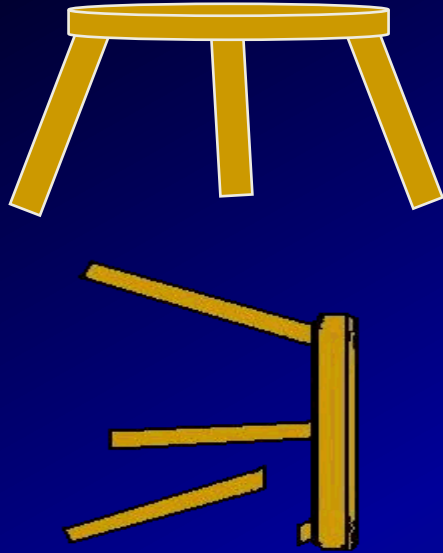


External Factors

- Environment
- Dog interaction
- Handler
- Functional Demands
- Design and Boundaries of Event



Internal Factors of Canine Performance



3 P's

Canine Performance is like a Three-Legged Stool.

- One leg is *body soundness*
- Second leg is *body conditioning*
- Third leg is *drive to perform*.
- If any one of the three is missing or dysfunctional, the stool is no good or does not function properly.



Canine Performance Impediments

What's Going to Hold Us Back

Fatigue

Conditioning

Pain

Structural

Drive

Psychological

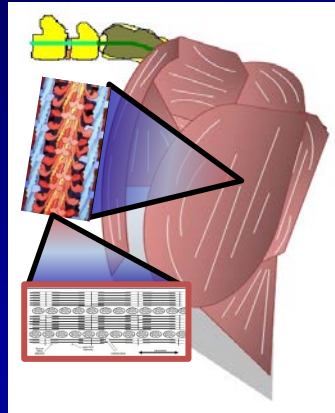
3 P's

Complexity of Canine Activity

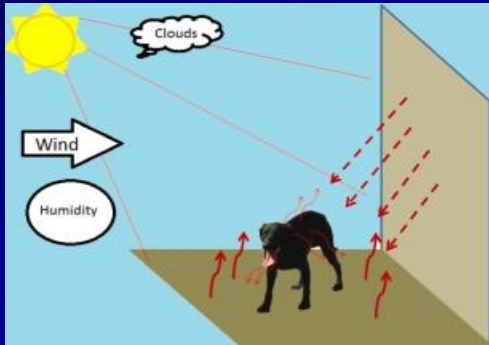
This is what is going on



Structural



Physiological



External



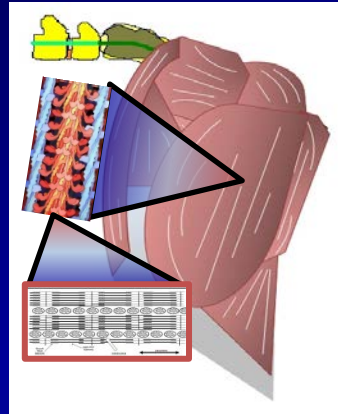
Mental

This is what you see



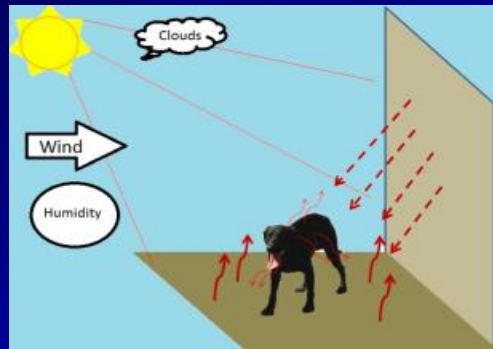
Complexity of Canine Activity

This is what is going on



Structural

Physiological



External

Robert L. Gillette, DVM, MSE, DACVSMR

This is what you see



Mental

Psychological Stresses & Performance

- The excitement and the conditioning of dogs bred and trained for athletic activities affect the metabolism of the Canine Athlete or Working Dog
- This Psychological factor will affect the Physiological state of the dog
 - Fatigue
 - Performance Abilities
- Retriever, Foxhound and Sled Dog studies



Gillette and Angle (2011) Journal of Applied Animal Behavior

Reward or Incentive Excitement

Secondary

- Dog is rewarded for performing the task
- Ball Drive
 - Dog performs task to receive reward

Primary

- Dog wants to perform task
- Performing task is reward

Purpose Bred for Task Performed

- Dogs not specifically bred or trained for the performance activity being tested would not be as psychologically stimulated to perform the task.
- These factors should be considered in studies of athletic canine performance.



TPR and Excitement

- One Greyhound ran over the sprint path while the other was held to watch the run
- The Greyhounds were split into two groups and paired by gender and size
- One group watched the activity while the other group ran. The next day the groups were switched.
- The Greyhounds ran four times over a two week period.
- The five time points of capture were:
 - Rest (24 hr prior)
 - pre-exercise (pre),
 - immediate post-exercise (po)
 - 30 minutes post exercise (30min)
 - Kennel (60-90 min)



Study Design

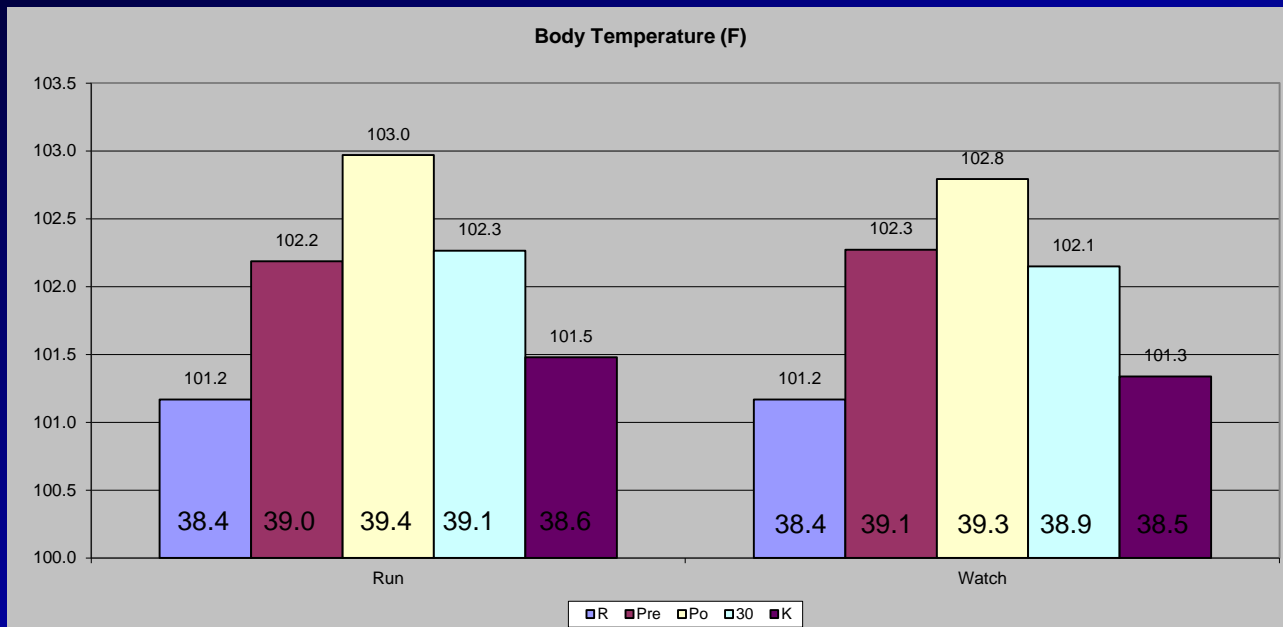


Run vs Watch



Run vs Watch Values

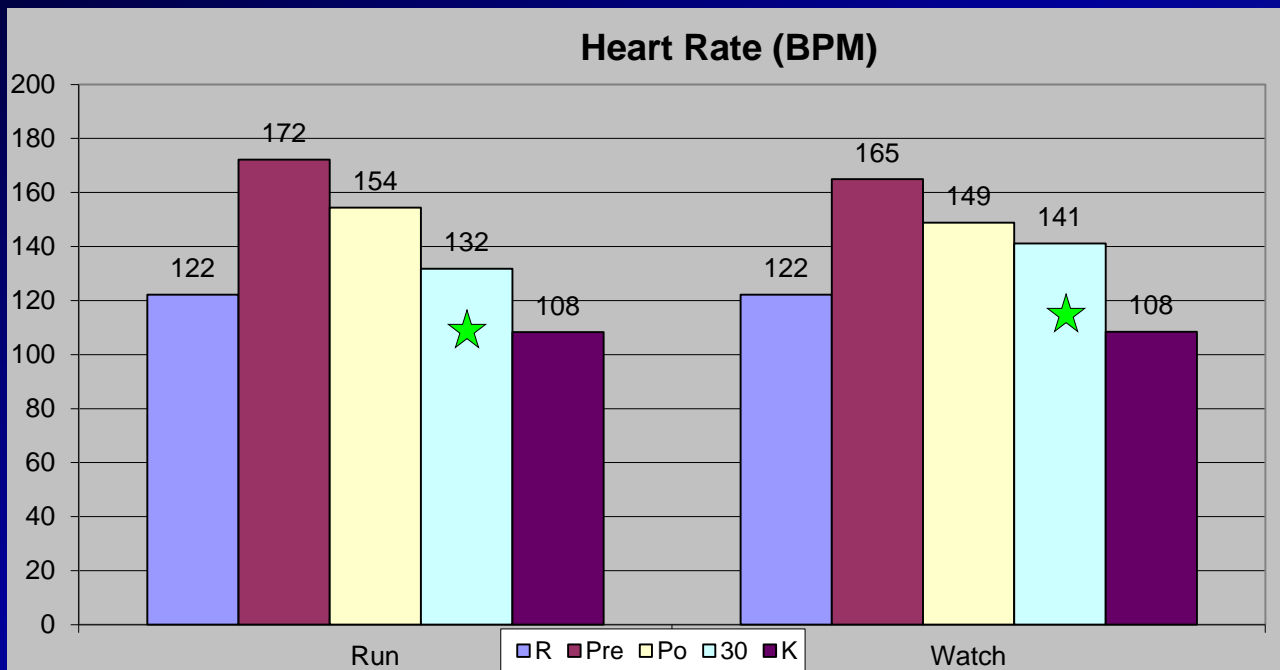
Rectal Temperature (°F)





Run vs Watch Values

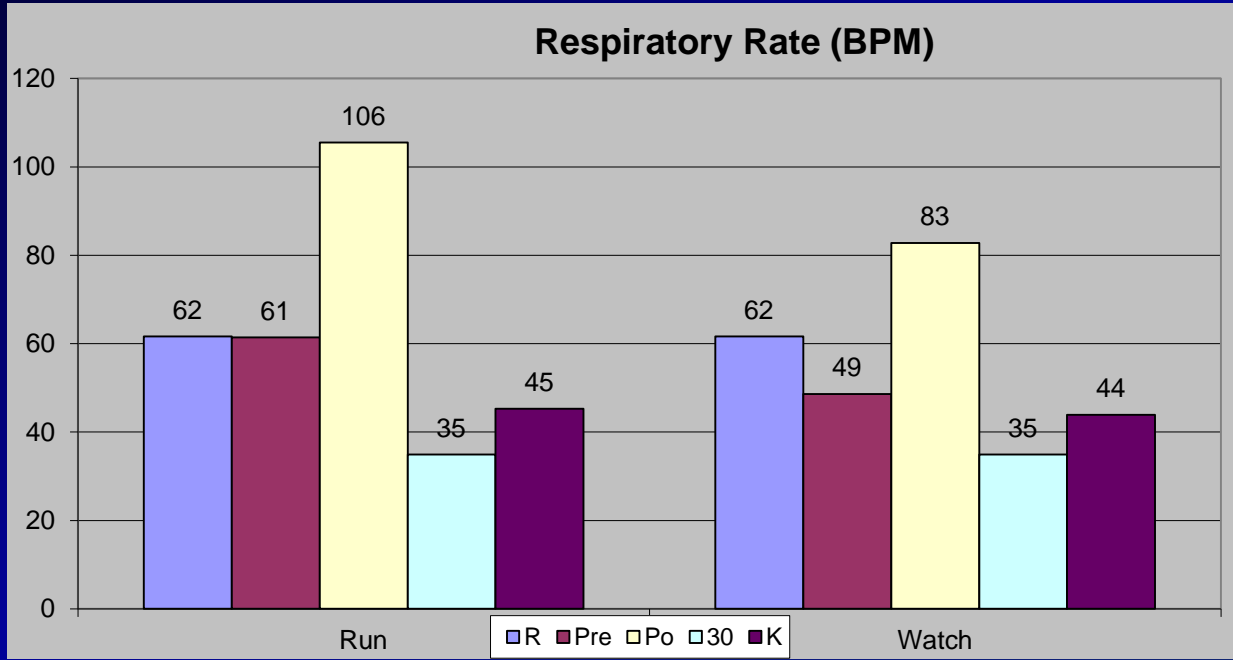
Heart Rate (BPM)





Run vs Watch Values

Respiratory Rate (BPM)



Performance

Psychology and Physiology

- Very important relationship in the Athletic and working dog.



Psycho/Social

- The excitement of dogs for athletic activities affect the metabolism of the Canine Athlete or Working Dog.
- Conversely dogs in new or abnormal settings may not be excited or may be fearful
 - Fatigue
 - Performance Abilities
- Dog/Animal interaction will be a factor

DeLuca, D. C., Murphree, O. D., & Angel, C. (1974). Biochemistry of nervous dogs. The Pavlovian journal of biological science: official journal of the Pavlovian, 9(3), 136-148.



Dog/Handler Variances
Dog/Dog Issues

Psycho/Social

Acclimation or Socialization

- Develop Routine
 - Maintaining a routine helps provide some normality in abnormal situations
- Social Experience
 - Helps to acclimate dog
 - Helps handler to understand dog's reactions
- Leash or Control
 - Behavior Control will change in new environment & experiences



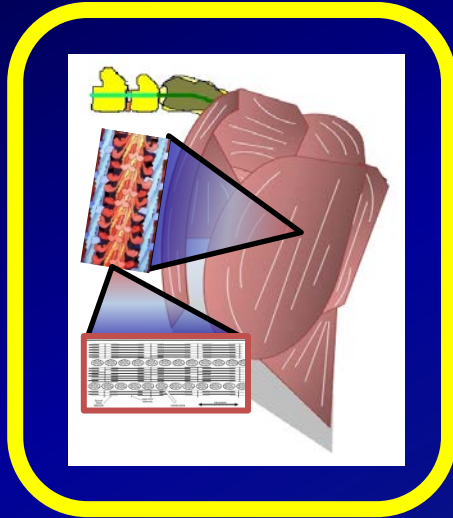
Complexity of Canine Activity

This is what is going on

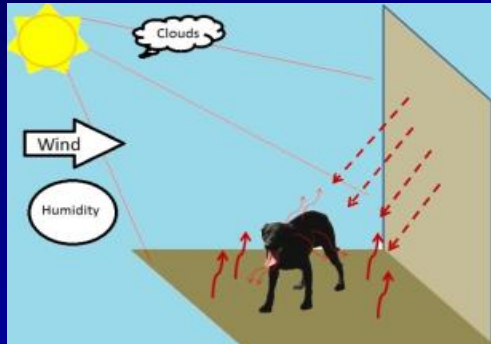


Structural

Physiological



This is what you see



External



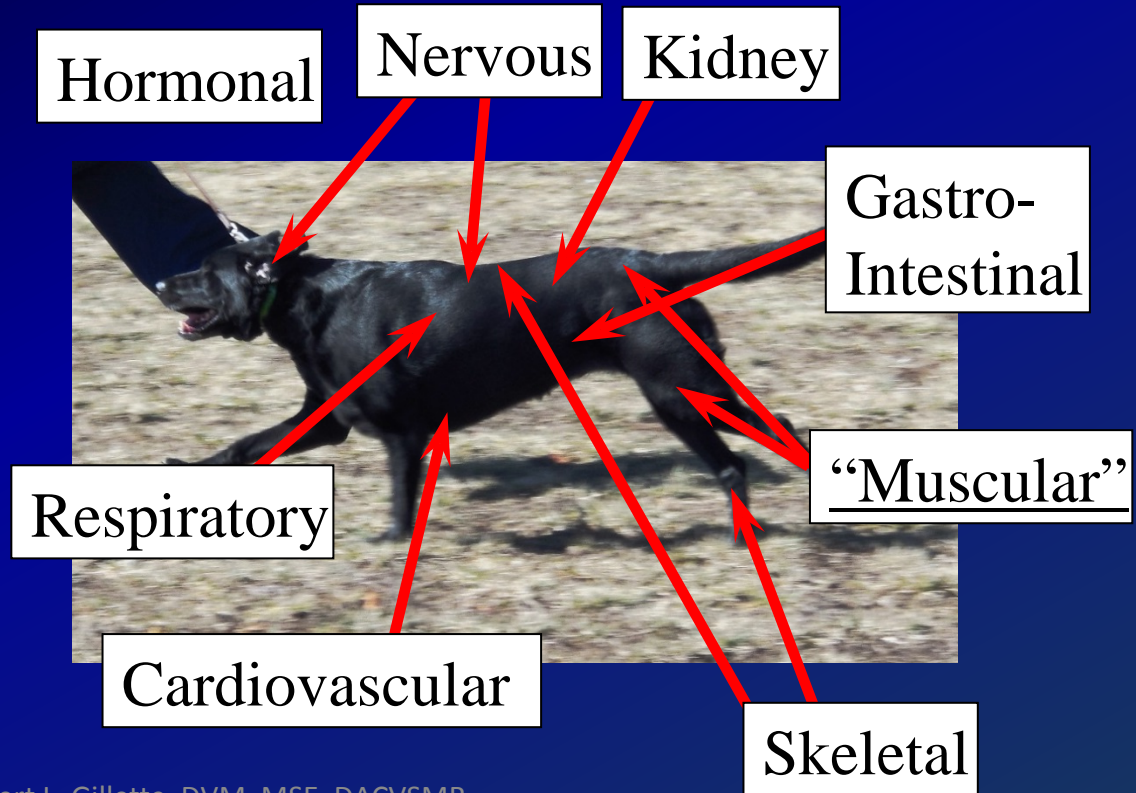
Mental



The Body's Systems work together for life and action

The systems of the body need to work together in a harmonious manner

- Bones provide structure
- Muscles act to move the structure
- Nerves stimulate movement
- Others manage the body's metabolic state during activity
 - Hormones, Respiratory, Kidney, Cardiovascular, GI



Health and Conditioning

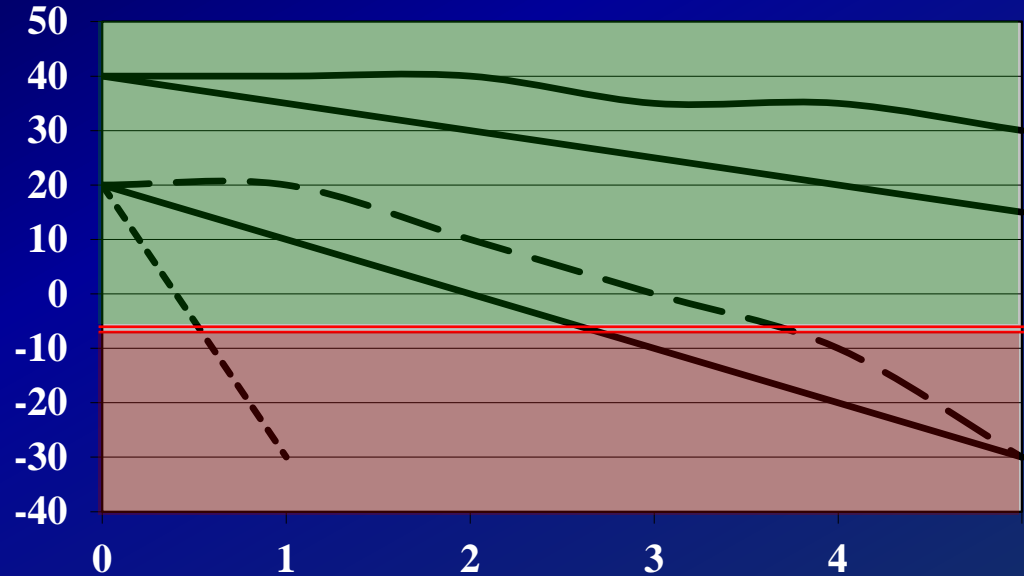
- When the dog is conditioned properly to perform an event, its energy and thoughts are focused towards performing the tasks of the event.
- Dogs that are not conditioned properly must deal with the affects of fatigue.
 - They are not mentally focused on their tasks, which limits their ability to perform.
 - As the body becomes fatigued it has an increased risk of injury.



Minimizing Metabolic Damage

Avoid Negative Metabolism

- Work Amount
 - Hi Energy
 - Low Energy
- Work Time
 - Period
 - Day
 - Consecutive
 - Career



Categories of Activity

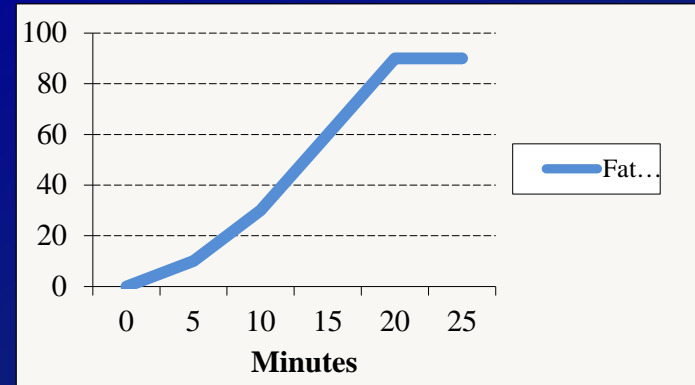
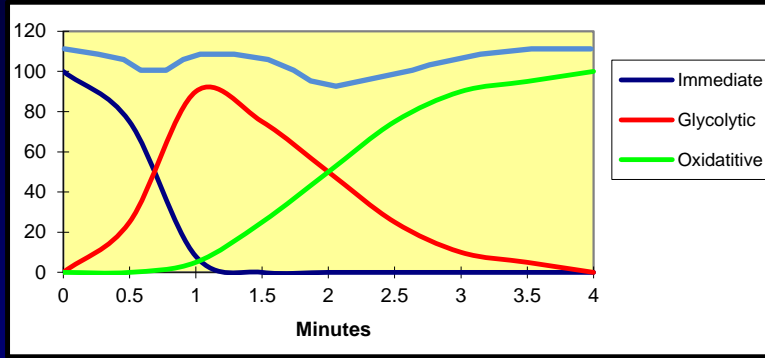


- Strength / Power
 - Short Duration
 - < 2 minutes
 - Performed at maximal or supramaximal intensities



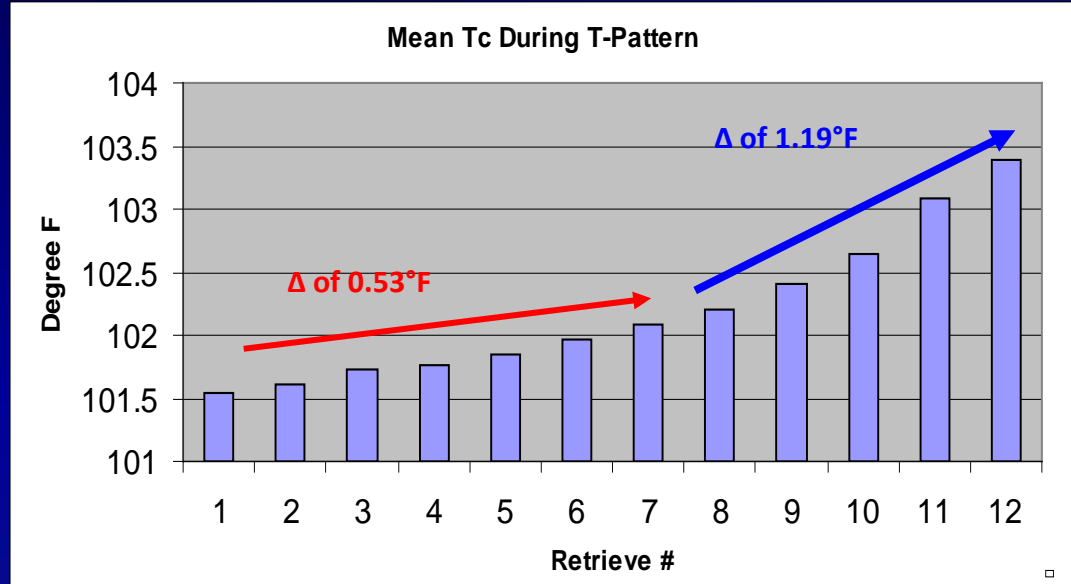
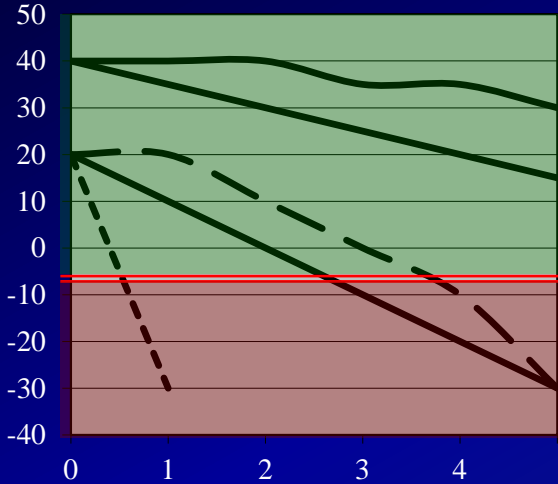
- Endurance
 - Long Duration
 - Longer than 2 minutes
 - Performed at intensities less than 90% maximal aerobic power (VO₂ max)

Energy Contributions During Exercise



Metabolic Fatigue Point Retrieving Exercise

Mean Tc after each retrieve during the 72 m retrieve (144 m).



Increase in Tc of 0.53°F for the first seven retrieves and an increase of 1.19°F for the last five retrieves.

Training and Conditioning Analysis of the Foxhound

Before

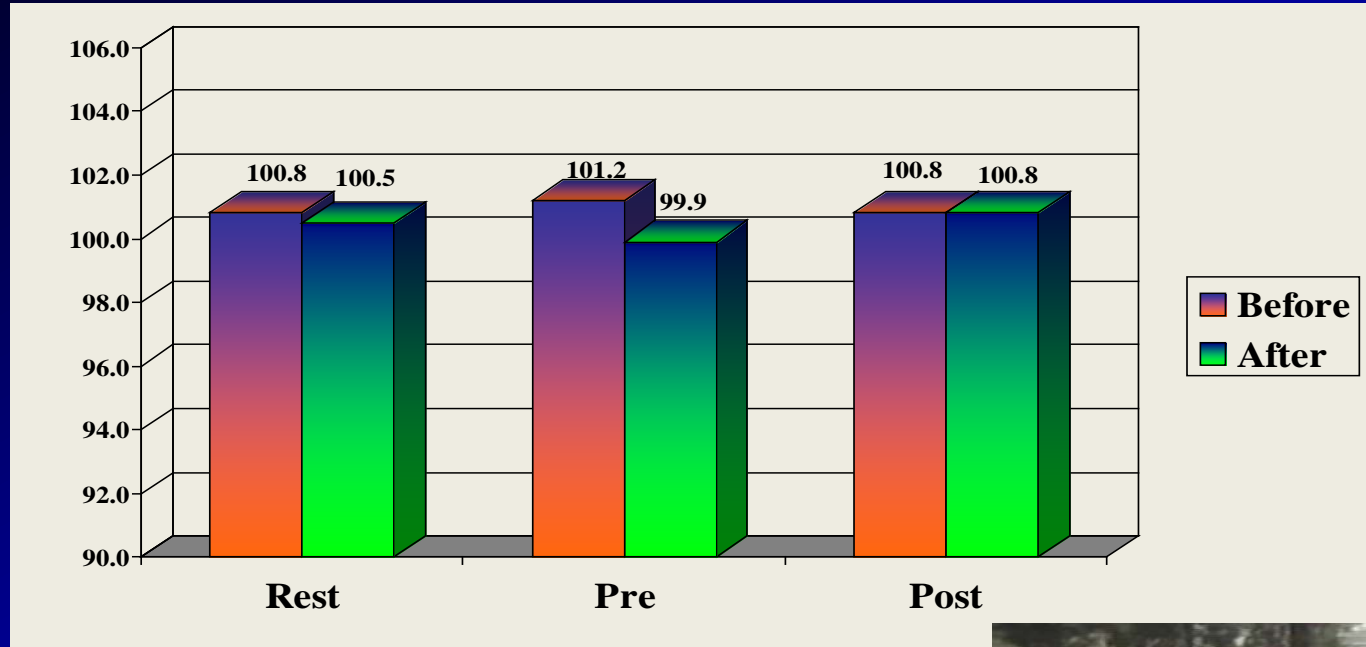
After

	B-Pre	NS-Rest	NS-Pre	NS-Post	R-Pr	Pr-Po	A-Post	NS-Rest	NS-Pre	NS-Post	R-Pr	Pr-Po
Glucose	89.5	90.6	77.7				100.9	107.5	96.2			
Urea Nit	22.1	21.8	23.1				23.4	23.5	18.6			
Creat	1.3	1.2	1.3				1.2	1.2	1.2			
TP	7.4	6.9	6.9				7.2	7.5	7.0			
Albumin	3.3	3.2	3.3				3.3	3.4	3.2			
Bili Tot	0.1	0.1	0.2				0.1	0.1	0.1			
AP	23.0	21.0	13.9				48.8	38.0	49.1			
ALT	31.5	29.3	45.2				39.6	47.7	49.2			
AST	39.7	37.5	103.6				35.3	33.9	37.3			
Cholest	158.3	155.7	153.5				171.1	175.5	162.8			
Calcium	10.0	9.4	9.2				9.7	10.1	9.5			
Phosph	4.0	4.4	3.9				3.9	3.6	4.0			
Sodium	148.7	147.9	146.6				144.8	148.5	144.3			
Potassium	4.3	4.3	3.9				4.2	4.4	4.0			
Chloride	114.4	111.9	110.5				111.6	110.7	111.0			
A/G	0.8	0.9	1.0				0.9	0.9	0.9			
Bun/Creat	16.3	16.6	16.8				18.8	18.1	14.1			
Globulin	4.1	3.7	3.6				3.9	4.1	3.8			
Lipase	224.6	226.4	174.9				219.5	195.9	205.0			
Amylase	740.8	767.0	833.6				639.3	681.2	645.3			
Triglyc	21.3	31.7	33.7				35.3	39.1	30.0			
CPK	131.2	107.0	652.7				129.2	83.8	121.6			
GGTP	4.5	6.1	1.4				3.1	4.1	1.9			
Mag	1.6	1.7	1.6				1.6	1.9	1.6			
Osmol	297.4	296.7	292.4				291.2	298.7	287.8			
Corr Calc	9.5	9.1	8.8				10.1	10.1	9.9			
CPK	131.2	107.0	652.7				9.3	10.3	10.0			
Cortisol	0.8	1.3	3.2				1.4	1.3	0.6			
Insulin	2.2	0.7	0.1				1.5	2.6	0.4			

$P < 0.05$

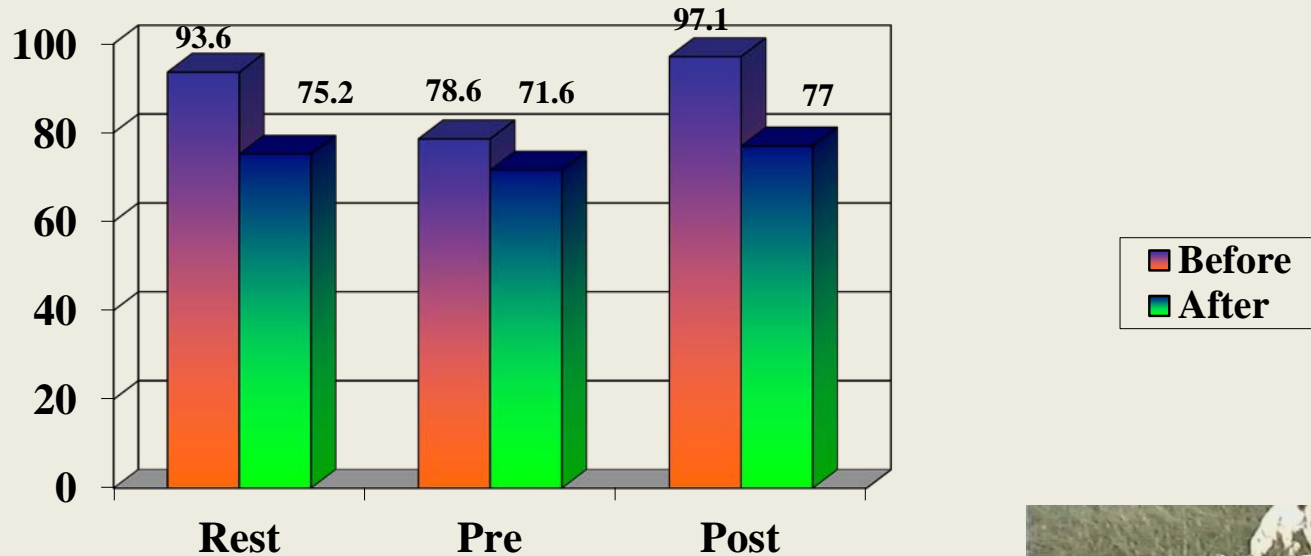
Body Temperature Related to Conditioning

Pre-Conditioning Versus Post-Conditioning



Heart Rate Related to Conditioning

Pre-Conditioning Versus Post-Conditioning



Sled Dog Field Study

Field Studies in the Training Sled Dog
Gillette, Angle, Adkins & Geske

Cond	B	A		B	A		B	A	
Blood Parameter	Rest	Rest		Pre	Pre		Post	Post	
Hemaglobin	17.394	17.411	█	16.73	16.94	█	17.14	16.89	█
Hematocrit	53.23	56.30	█	52.27	52.92	█	52.37	52.98	█
WBC	12.06111	8.955556	↓	10.64	8.62	↓	10.09	8.75	↓
RBC	7.40	7.49	█	7.38	7.27	█	7.29	7.28	█
MCV	72.00	75.22	↑	70.94	72.94	█	72.00	72.76	█
MCH	23.52	23.27	█	22.69	23.29	↑	23.54	34.98	█
MCHC	32.66	30.96	↓	32.01	32.04	█	32.71	32.01	█
Platlet Count	246.17	287.67	█	269.17	305.94	█	276.21	316.94	█
Neutrophils	6979.22	5161.44	↓	6043.56	5076.89	█	5601.07	5319.00	█
Lymphocytes	2892.17	2244.28	↓	2655.89	1993.28	↓	2950.21	1867.59	↓
Monocytes	382.89	265.89	↓	342.17	247.17	█	238.36	252.71	█
Eosinophils	1776.39	1256.44	█	1602.83	1220.78	█	1230.36	1296.94	█
Basophils	35.44	27.50	█	0.00	61.22	█	65.71	28.47	█



- The affects of Conditioning
- CBC Values

Sled Dog Field Study

Gillette, Angle, Adkins & Geske

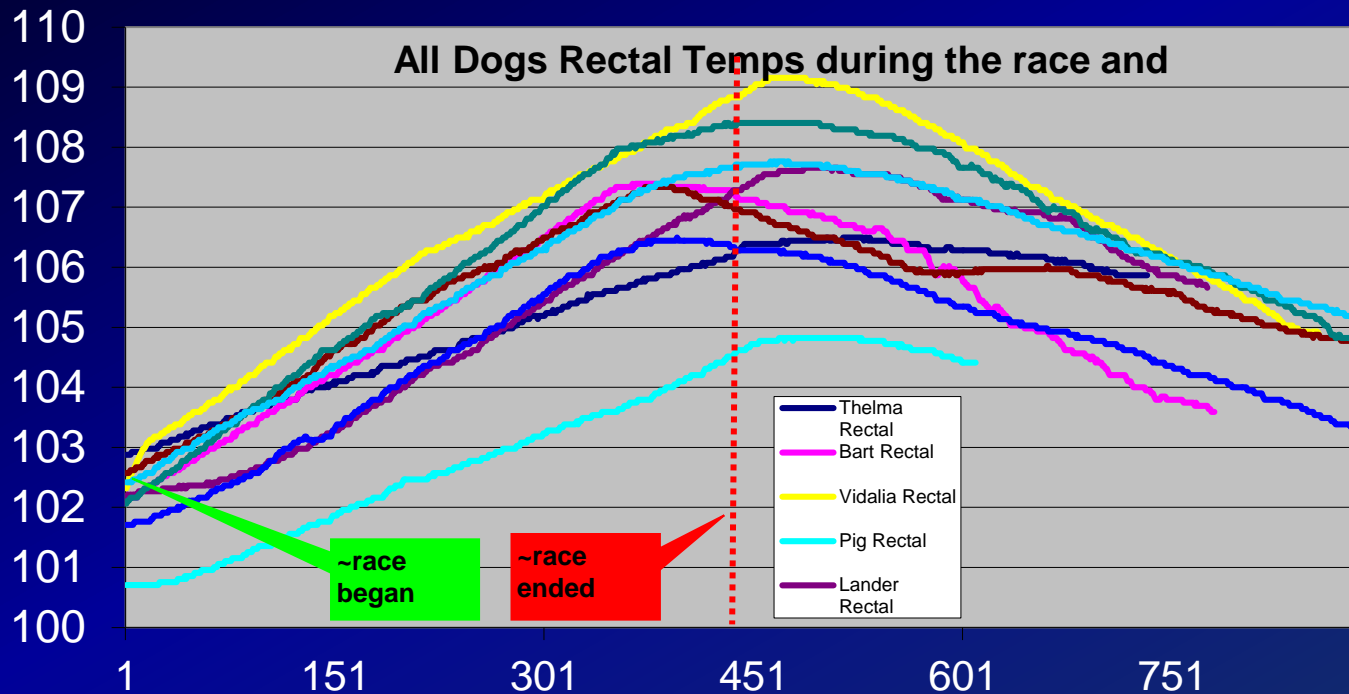
Chem Values

Cond	B	A		B	A		B	A	
Blood Parameter	Rest	Rest		Pre	Pre		Post	Post	
Glucose	104.00	98.56	↓	100.11	83.56	↓	174.86	215.67	█
Urea Nitrogen	17.83	21.67	↑	17.06	21.61	↑	18.71	20.61	↑
Creatinine	0.99	0.97	█	1.06	0.91	↓	1.34	1.16	↓
Total Protein	7.23	7.36	█	7.17	7.48	█	6.94	7.11	█
Albumin	3.61	3.31	↓	3.68	3.99	↑	3.63	3.13	↓
Total Bilirubin	0.10	0.10	█	0.11	0.12	█	0.11	0.12	█
Alkaline Phosphata:	41.39	46.06	█	36.46	36.44	█	44.57	45.44	█
ALT(SGPT)	43.94	50.83	█	42.33	47.50	█	45.14	49.17	█
AST(SGOT)	33.17	36.28	█	33.72	29.28	█	38.71	42.22	█
Cholesterol	196.78	193.00	█	195.39	203.94	█	194.43	181.28	█
Calcium	9.68	9.64	█	9.53	10.51	↑	8.51	9.42	↑
Phosphorous	3.77	3.81	█	3.73	3.50	█	3.32	3.42	█
Sodium	145.83	148.89	↑	147.56	150.72	↑	146.57	147.61	█
K	4.61	4.58	█	4.77	4.71	█	4.69	4.40	█
CL	113.11	111.83	█	112.89	116.83	↑	111.86	111.78	█
Albumin/Globulin/R:	1.07	0.86	█	1.14	1.26	█	1.17	0.84	█
BUN/Creatinine Rati	18.22	22.50	█	16.39	25.17	█	14.14	18.17	█
Globulin	3.62	4.05	█	3.48	3.49	█	3.31	3.97	█
Lipase	483.89	535.17	█	493.50	552.06	█	486.57	516.33	█
Amylase	462.50	404.11	█	469.50	407.67	█	435.07	387.67	█
Triglycerides	50.00	45.33	█	50.56	34.39	█	68.29	56.89	█
CPK	79.06	100.72	█	81.67	102.89	█	93.86	125.56	█
GGTP	7.87	6.27	█	6.00	7.09	█	6.00	6.17	█
Magnesium	1.80	1.82	█	1.76	1.78	█	1.64	1.79	█
Calculated Osmolali	291.94	283.61	█	294.94	301.44	█	297.64	302.11	█
Corrected Calcium	8.70	9.92	█	9.83	11.00	█	8.62	9.77	█
CPK	79.06	100.72	█	81.67	102.89	█	93.86	125.56	█
Cortisol	1.69	1.68	█	3.31	3.68	█	6.66	5.60	█
Insulin	3.87	4.46	↑	2.90	3.53	█	5.31	3.60	█
Ratio	5.33	6.44	█	4.09	6.67	█	4.60	2.88	█
Glucose	104.00	98.56	↓	100.11	83.29	↓	174.86	215.67	█
Glucose	104.00		█						█
T4		2.18	█						█



Physiological Factors

Sled Dog Working Body Temps

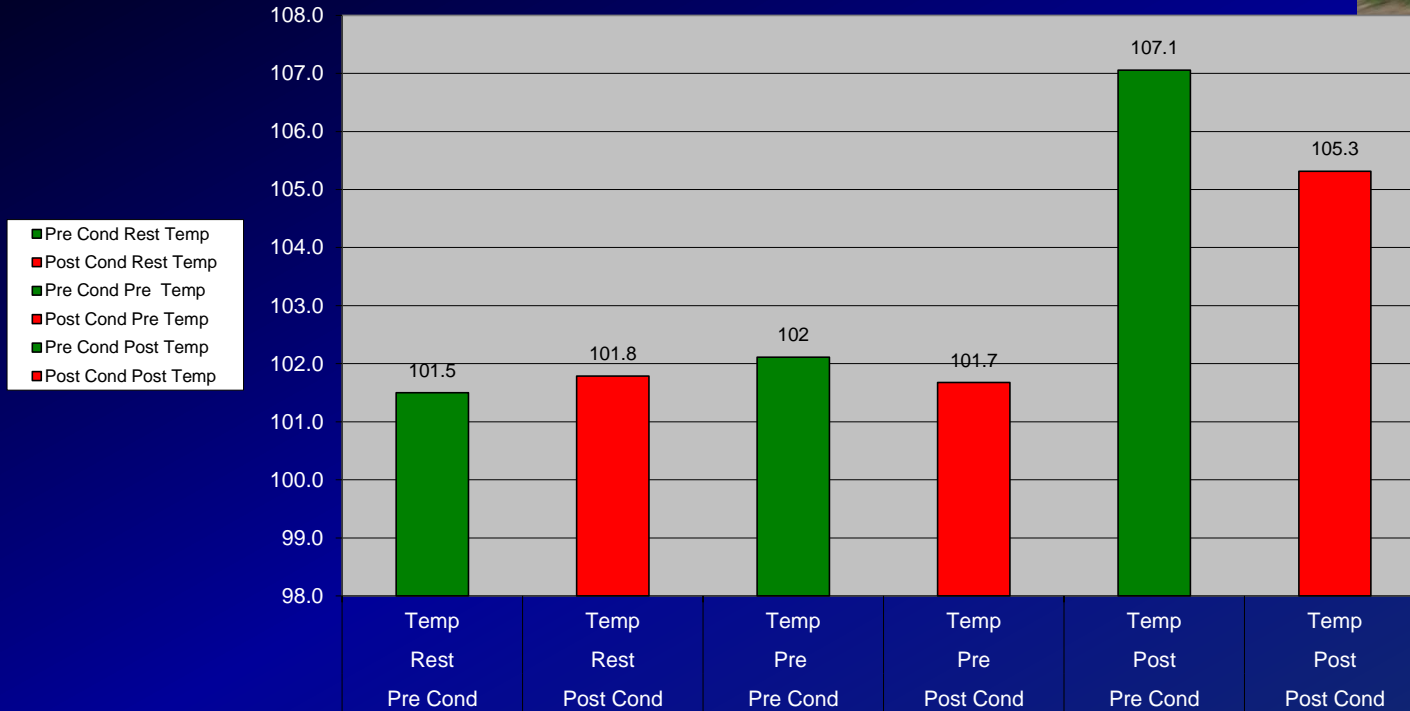


3 mile race

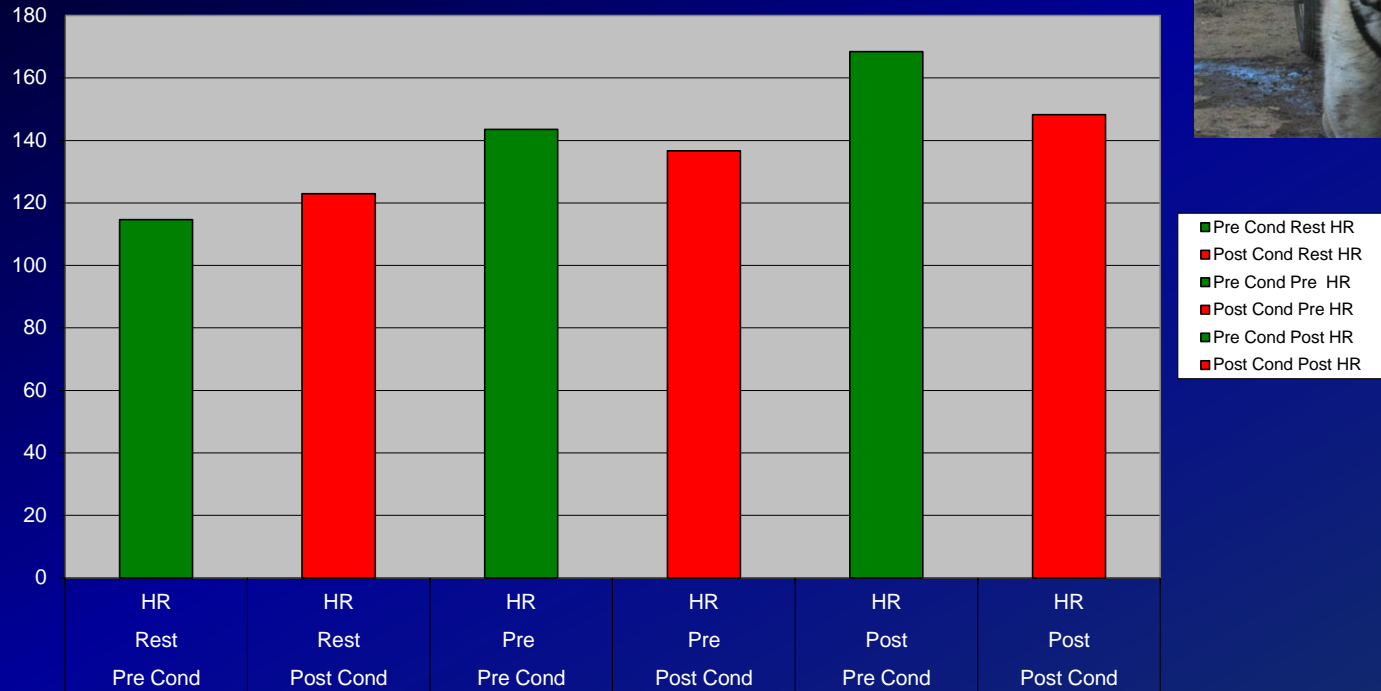
Pre Cond vs. Post Cond Temp



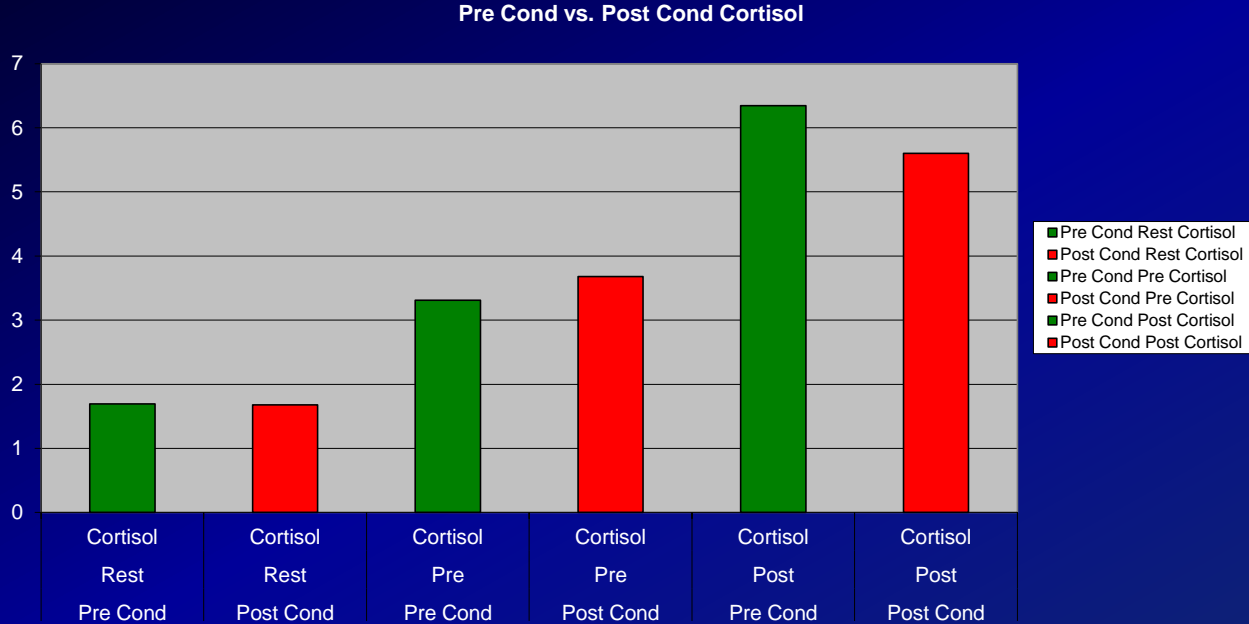
Pre Cond vs. Post Cond Temp



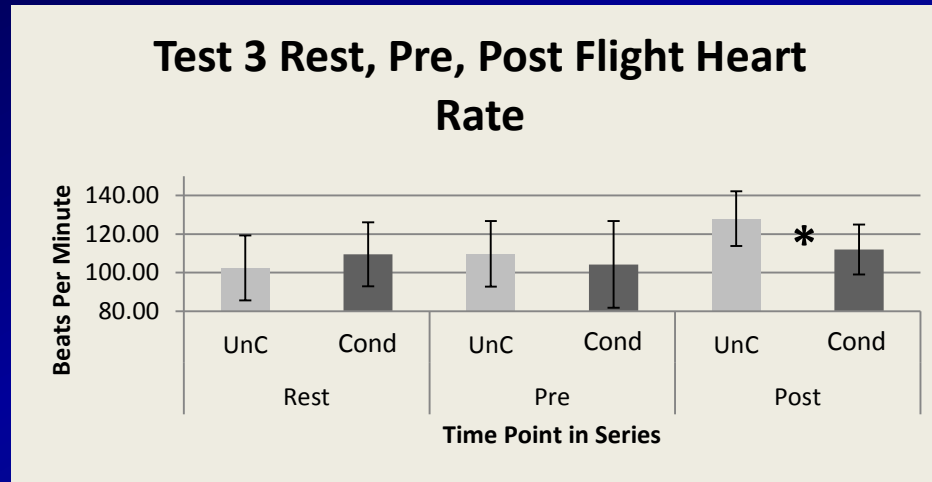
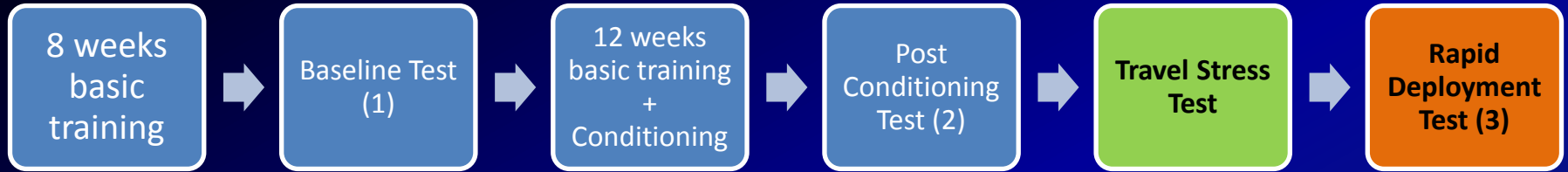
Pre Cond vs. Post Cond HR



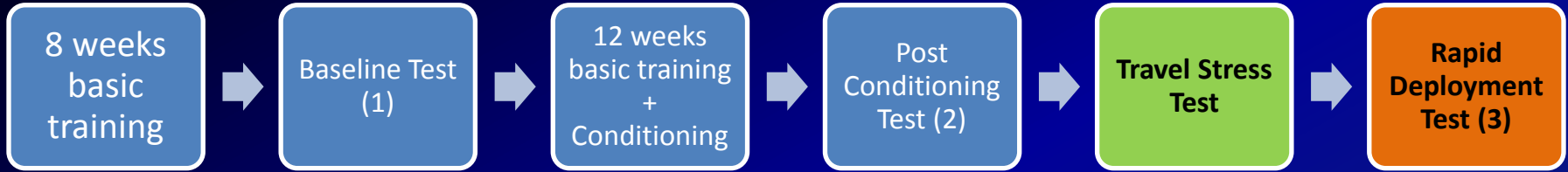
Pre Cond vs. Post Cond Cortisol



Conditioning and Travel Stress



Conditioning and Rapid Deployment Test

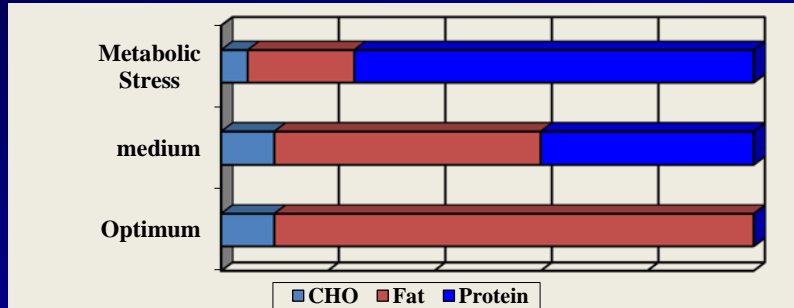


Parameter	Conditioned	Unconditioned
# of targets located (42 g, AN/SP)	120/131	95/103
% targets found (NS)	93.9 ± 6.5 %	90.9 ± 16.4 %
No Finds	11	8
No Find: change in behavior	0	0
No Find: dog walked by aid	11	8
No Find: dog not in area	0	0
Search Time (NS)	2105 ± 797 seconds	1721 ± 736 seconds
Search Distance (NS)	2.5 ± 0.8 km	2.24 ± 0.9 km

Note: Non sig due to small sample size

The Effects of Conditioning and Fat supplementation in a Pack of Foxhounds

- Fat Supplements
 - Animal Fat
 - Corn Oil



Pr-S

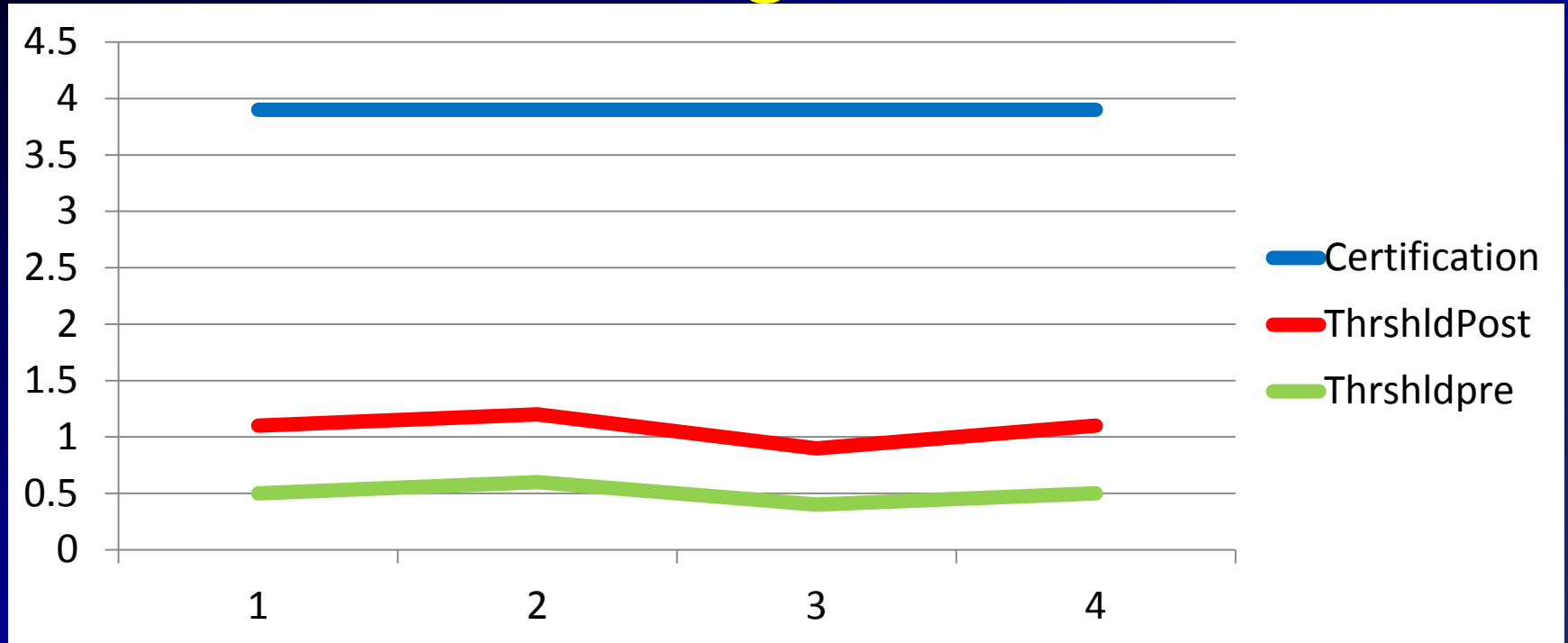
Po-S

B-Pre	S-Rest	S-Pre	S-Post	R-Pr	Pr-Po
Glucose	94.8	90.2	72.9	Green	Red
Urea Nit	19.7	17.9	20.2	Green	Green
Creat	1.2	1.1	1.3	Blue	Blue
TP	7.6	7.3	7.1	Red	Green
Albumin	3.2	3.2	3.4	Green	Blue
Bili Tot	0.1	0.1	0.2	Green	Blue
AP	19.8	20.0	9.1	Green	Red
ALT	36.7	33.3	41.3	Green	Blue
AST	38.3	37.9	92.5	Green	Blue
Cholest	155.2	155.7	151.5	Green	Green
Calcium	10.2	9.6	9.1	Red	Red
Phosph	4.1	4.5	4.2	Green	Green
Sodium	146.8	147.8	145.9	Green	Red
Potassium	4.4	4.6	3.8	Green	Red
Chloride	113.6	110.9	108.7	Red	Red
A/G	0.8	0.8	1.0	Green	Blue
Bun/Crea	16.3	16.5	15.9	Green	Red
Globulin	4.4	4.1	3.7	Red	Red
Lipase	286.6	288.6	239.2	Green	Red
Amylase	880.4	864.4	787.8	Green	Green
Triglyc	21.9	30.2	33.0	Blue	Green
CPK	116.7	116.9	704.7	Green	Blue
GGTP	3.2	5.9	0.0	Green	Green
Mag	1.6	1.7	1.6	Green	Green
Osmol	294.3	294.9	289.7	Green	Red
Corr Calc	10.5	9.9	9.2	Red	Red
CPK	108.8	116.9	704.7	Green	Green
Cortisol	1.3	1.5	3.4	Green	Blue
Insulin	1.8	0.4	0.0	Red	Green

A-Post	S-Rest	S-Pre	S-Post	R-Pr	Pr-Po
Glucose	108.2	110.8	103.0	Green	Green
Urea Nit	23.7	19.0	13.2	Green	Green
Creat	1.1	1.1	1.1	Green	Green
TP	7.5	7.2	7.0	Green	Green
Albumin	3.3	3.2	3.3	Green	Green
Bili Tot	0.1	0.1	0.1	Green	Green
AP	38.0	42.6	54.8	Green	Green
ALT	34.7	35.7	37.4	Green	Green
AST	33.8	34.1	33.4	Green	Green
Cholest	153.4	151.0	152.1	Green	Green
Calcium	10.0	9.5	9.5	Green	Green
Phosph	4.3	4.0	3.8	Green	Green
Sodium	145.4	144.8	145.0	Green	Green
Potassium	4.3	4.3	4.0	Green	Red
Chloride	110.2	111.0	111.4	Green	Green
A/G	0.8	0.8	0.9	Green	Green
Bun/Crea	21.7	16.7	11.8	Green	Green
Globulin	4.2	3.9	3.8	Green	Green
Lipase	270.9	297.0	253.1	Green	Green
Amylase	834.3	818.7	827.7	Green	Green
Triglyc	51.3	37.9	42.3	Green	Green
CPK	131.1	195.9	154.3	Green	Green
GGTP	1.4	2.4	2.7	Green	Green
Mag	1.7	1.6	1.5	Green	Green
Osmol	292.9	290.0	287.4	Green	Green
Corr Calc	10.3	9.7	9.7	Green	Green
CPK	10.3	9.7	9.7	Green	Green
Cortisol	1.0	1.0	0.8	Green	Green
Insulin	5.9	3.5	0.2	Green	Green

P<0.05

Effects of Exercise on Scent Recognition



Angle, et al, (2014). The effects of exercise and diet on olfactory capability in detection dogs

Diet, Exercise, and Detection



- Dogs were 1.42 (1.082 – 1.87) times as likely to find a target on the CO diet relative to the HF diet ($p = 0.0099$) **CO > HF**
- Dogs were 1.49 (1.26 – 1.76) times as likely to find a target PRIOR to exercise relative to after exercise ($p < 0.0001$) **Pre > Po**
- There was no significant effect of TPR on the probability of finding the target ($p > 0.25693$) **TPR \neq Finds**
- Dogs on LF had higher Blood Cortisol levels than HF and CO ($p < 0.05$)

Angle, C. T., Wakshlag, J. J., Gillette, R. L., Steury, T., Haney, P., Barrett, J., & Fisher, T. (2014). The effects of exercise and diet on olfactory capability in detection dogs. *Journal of nutritional science*, 3.

The Handler & Dog Becoming a Team



Handler

Anatomical
Physiological
Psychological

Connected vs
Unconnected

Dog

Anatomical
Physiological
Psychological

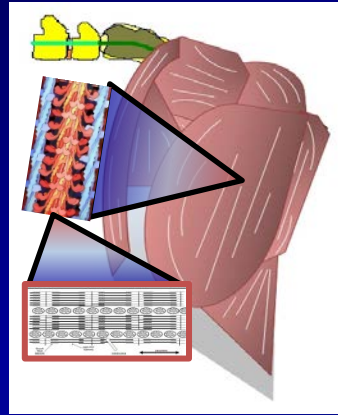
- Train to be one
- Handler Factors
- Dog Factors
- Interactive variances
 - Social
 - Climate
 - Terrain

Man/Dog
Anatomical
Physiological
Psychological

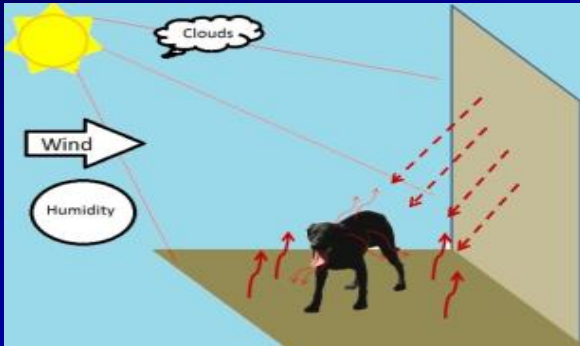
Structural Action and Energy



Structural



Physiological



External

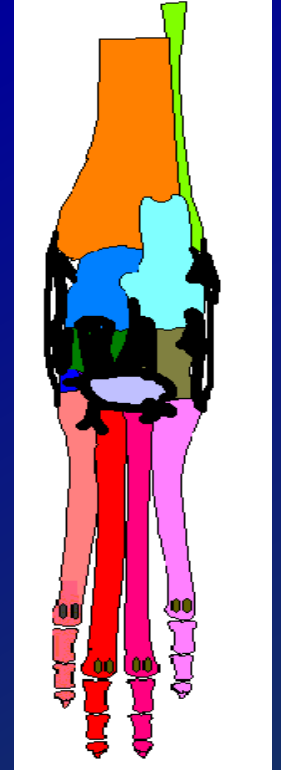
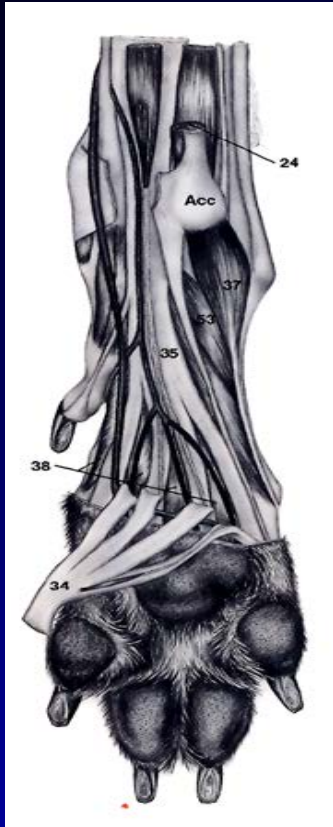


Mental

This is what you see



Structural Soundness and Performance Distal Limbs



Biomechanical Components

Whole Body Stressors & Segmental Stressors

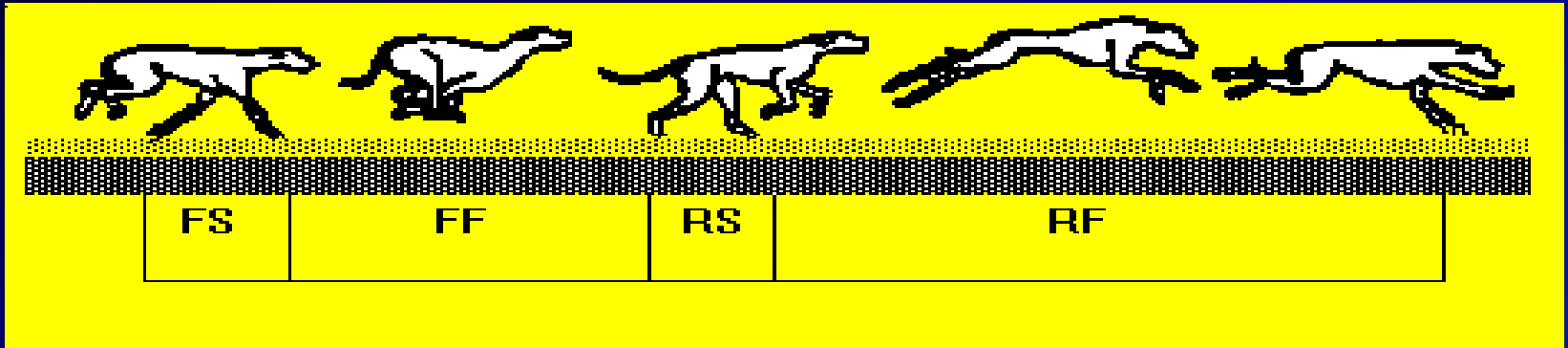
Whole Body Fatigue & Segmental Fatigue



Segmental Variation

Robert L. Gillette, DVM, MSE, DACVSMR

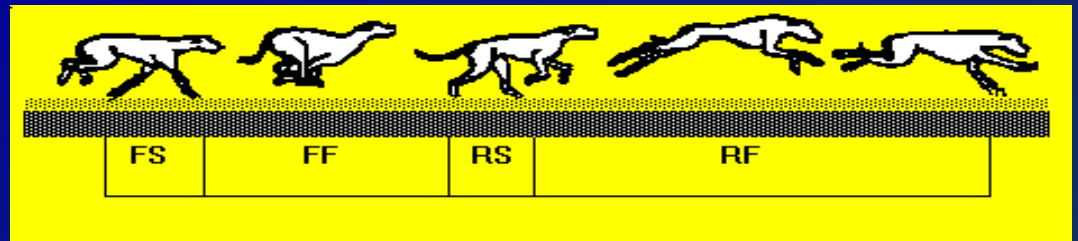
Greyhound Racing Gallop



- The Racing Gallop is a double-suspension rotary gallop
- Phases of the stride: Front Support (FS), Front Flight (FF), Rear Support (RS), Rear Flight (RF).

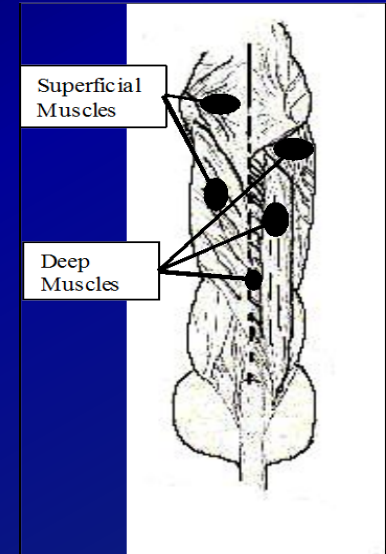
Factors of Fatigue

Parameter	Beginning	End	Significant
Velocity	16.45 m/s	14.58 m/s	S
Stride Freq	3.25 str/s	2.82 str/s	S
Stride Lngth	5.06 m	5.17 m	NS
Tot Sp Time	0.187 s	0.225 s	S
Tot Flt Time	0.122 s	0.130 s	NS
Ft Flt Dist	1.23 m	1.42	S
Rr Flt Dist	2.50 m	2.32 m	S



Kinematic Factors of Fatigue

- Stride length had no significant change
- Rear flight distance decreases & front flight distance increases
- Fatigue occurs in the vertebral muscles
 - Longissimus muscles



Normal Forces of Activity

- Propulsion of the Rear Limbs
- Lift of the Paravertebral Muscles
- Energy transfer of the front limbs
- Energy absorption of the front limbs



Normal Forces of Activity

- Dogs are active and will be exposed to various physical forces
- Minimize unneeded injuries
- Prepare the musculoskeletal structure to handle the rigors of work
- Will decrease deleterious stresses and injuries

Preparing the Canine Structure

Wolff's Law

Bone in a healthy person or animal will adapt to the loads under which it is placed.

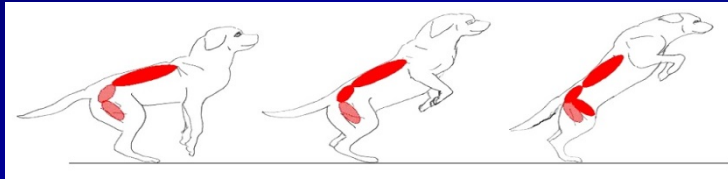
Davis's Law

The related soft tissue in a healthy person or animal will adapt to the load under which it is placed



Structural Preparation

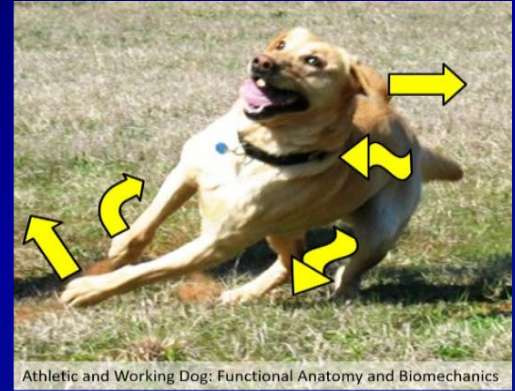
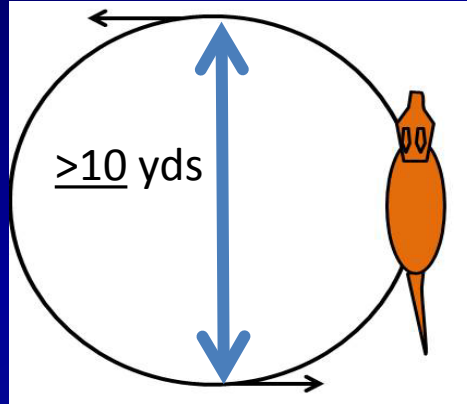
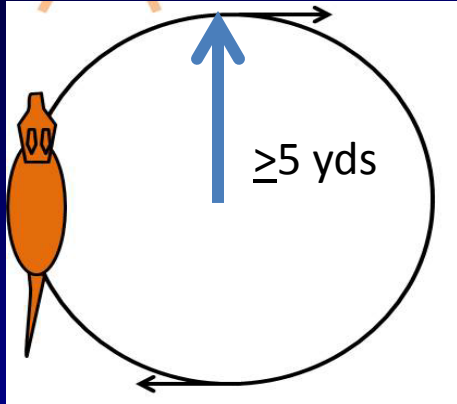
Increase Speed
Prepare Structure



- Speed Factors
 - Stride Length
 - Stride Frequency*
- Exercises
 - Uphill work
 - Hurdles – Tight Distance
 - Wet Sand - Sprints
- Physical Conditioning
 - Circular activity
 - Large Figure 8's
 - Loping Speeds
 - Sand work
 - Soft Sand (Leash?)
 - Loping Speeds



Structural Preparation

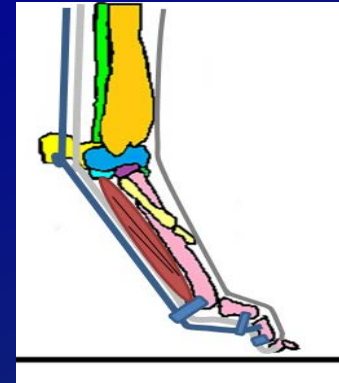
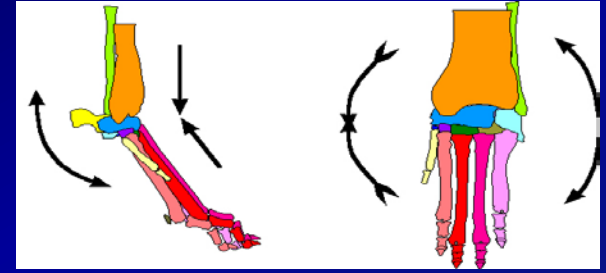
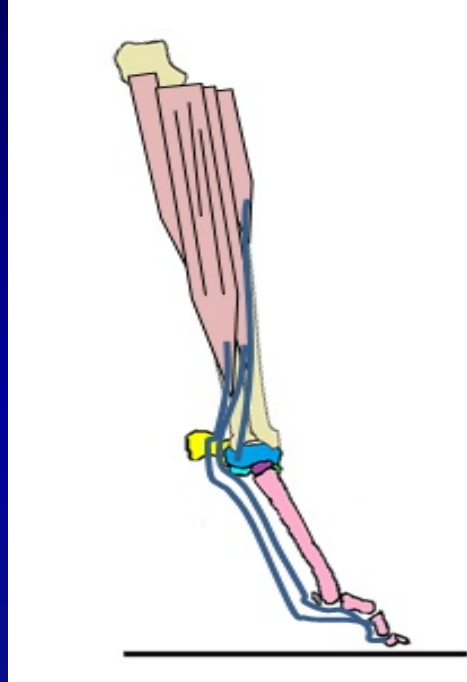
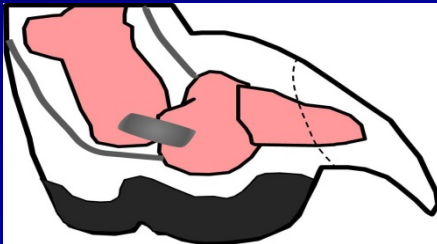


Turning:

- Lunging or Figure 8's
- Loping Speeds

Condition the Structure

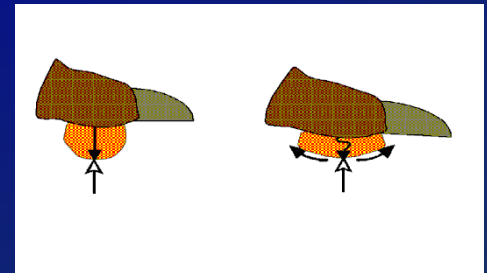
- Understand
 - Activities
 - Inactivity
 - Workload
 - Environment
 - Surface



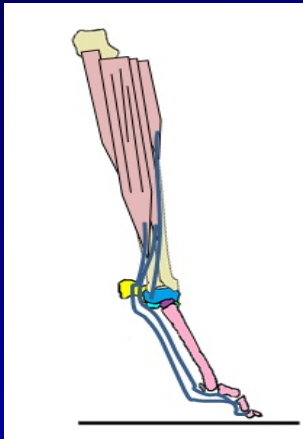
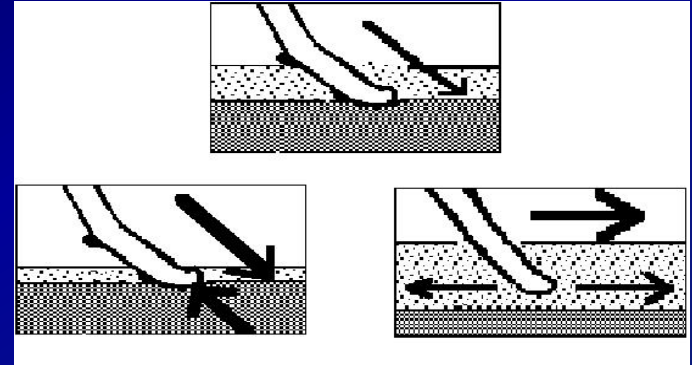
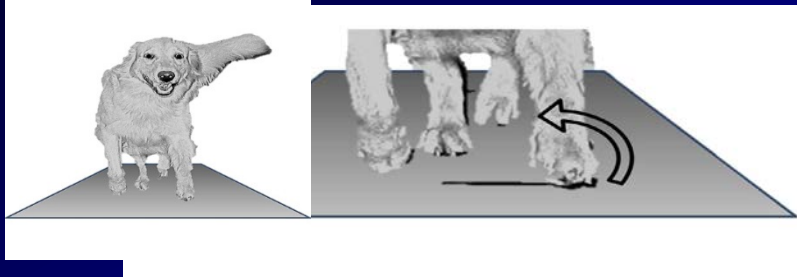
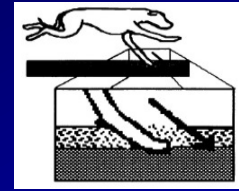
Distal Muscles

Paw Injuries

Prevention



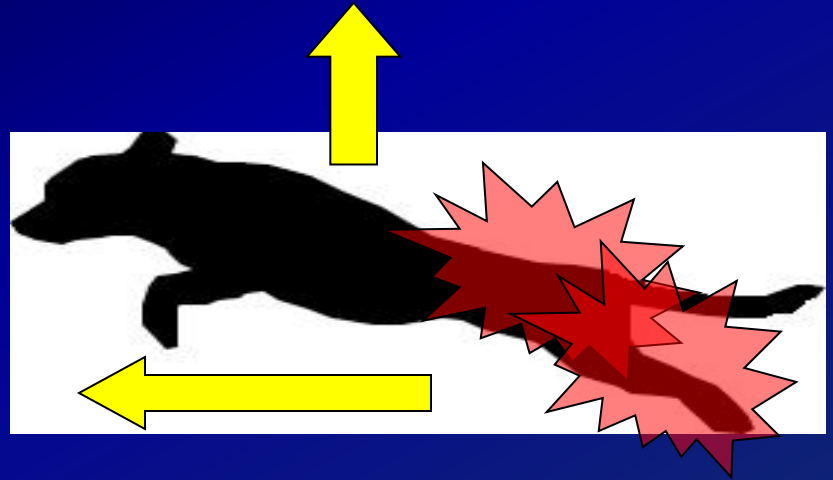
Structural Preparation



- Grass or Sand (wet or soft)
- Be careful in soft sand

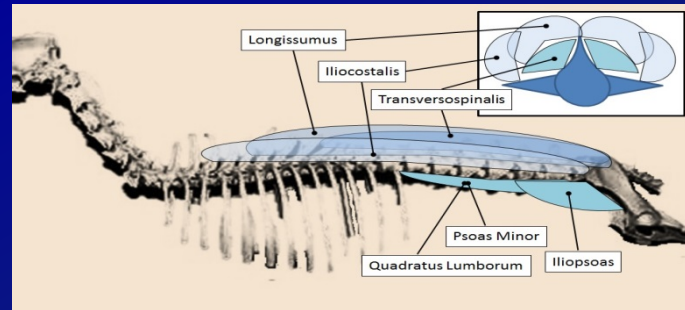
Lumbo-Sacral Issues****

- Jumping Issues
- Pain
- Intensity related
 - Drive
 - Obedience vs Protection work
- Age



Muscle Soreness in Lower Back

- Secondary/Tertiary Inflammation and Pain
- Epaxial and Hypaxial Muscles
- IVDD
- Nerve Root
- Treatments
 - Meds
 - Laser
 - E-Stim

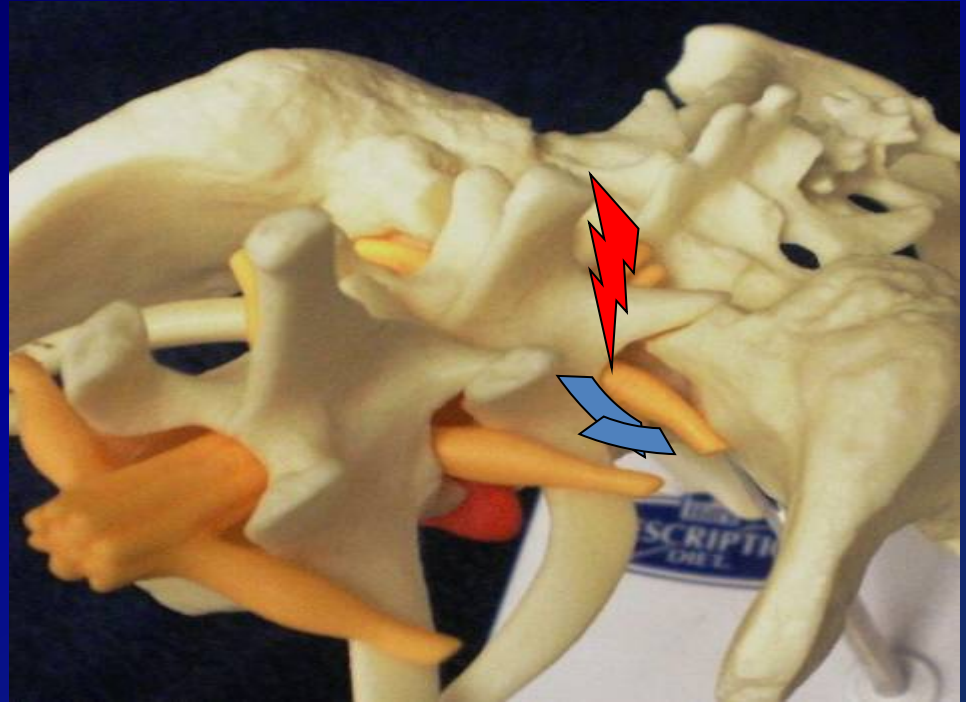


Lumbosacral Pain



Fibrous tissue growth around
the nerves creates nerve
impingement

This create nerve pain



Don't Forget Muscles or IV joint Pain

Tick Borne Pathogens in Detection Dogs and Patrol Dogs

- Athletic and Working Dogs are exposed to various pathogens
- Subclinical pathology
- Off performance or reduced endurance
- Ehrlichiosis
- Rocky Mountain Spotted Fever
- Lymes
- Anaplasmosis



Optimizing Detection Dog Performance: Addressing the Factors of Psychology, Metabolism and Structure

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