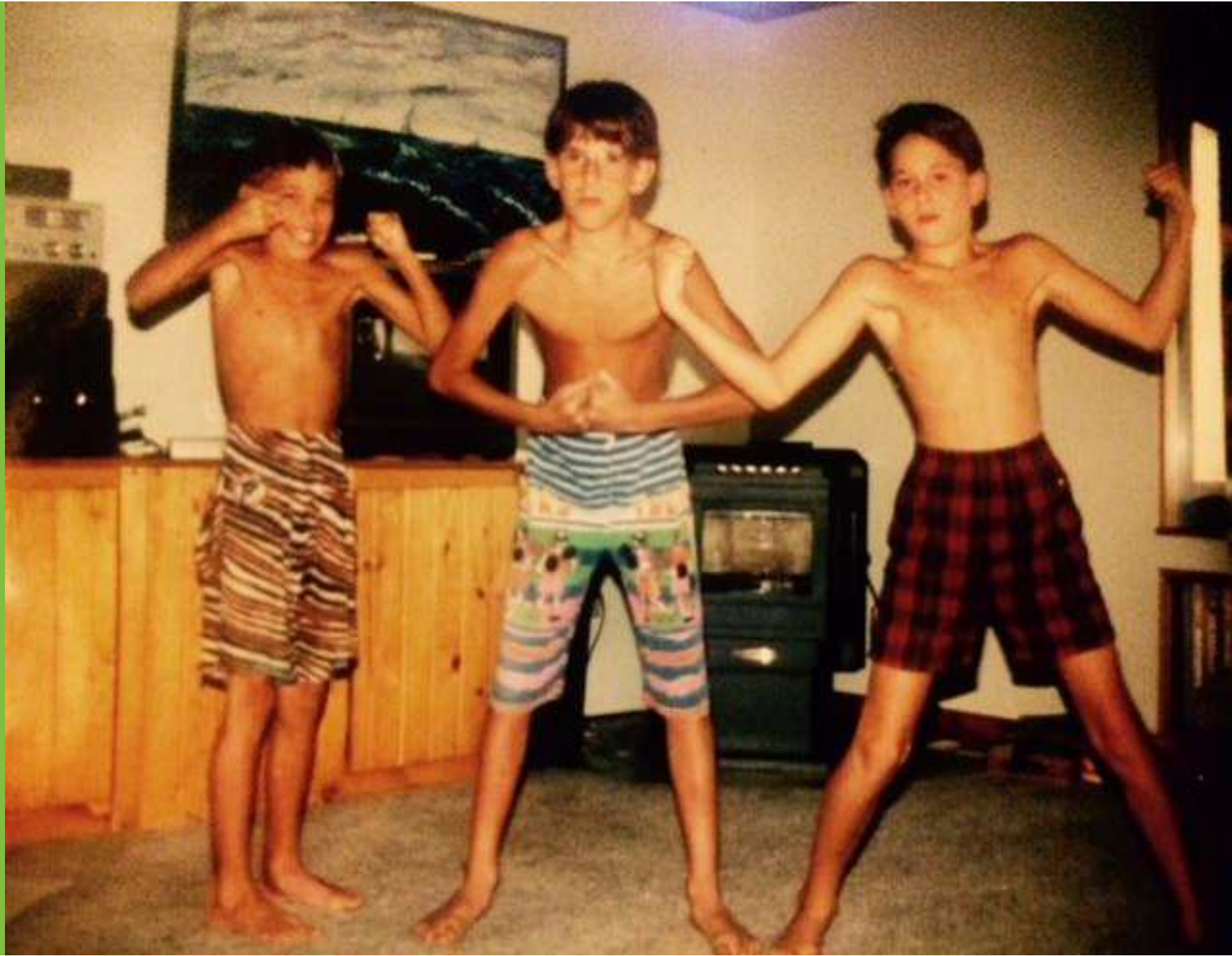


Fire & Ice The Benefits & Science Of Hyper & Hypothermia



BenGreenfieldFitness.com/pfx2020











Fire







Endurance Benefits

- Improved cardiovascular mechanisms and lower heart rate
- Improved thermoregulatory control, which operates by activating the sympathetic nervous system and increasing the blood flow to the skin and sweat rate
- Lower core body temperature during workload
- Higher sweat rate and sweat sensitivity as a function of increased thermoregulatory control
- Increased blood flow to skeletal muscle (muscle perfusion) for glucose, esterified fatty acids, and oxygen
- Reduced rate of glycogen depletion due to improved muscle perfusion
- Increased red blood cell count (erythropoietin)
- Increased efficiency of oxygen transport to muscles

Muscular Benefits

- Induction of heat shock proteins
- Induction of growth hormone response
- Improved insulin sensitivity
- Muscle maintenance during injury/immobilization



Muscular Benefits (HSP Induction)



- HSPs can prevent damage by directly scavenging free radicals and also by supporting cellular antioxidant capacity through its effects on maintaining glutathione
- HSPs can repair misfolded, damaged proteins thereby ensuring proteins have their proper structure and function

Muscular Benefits (Increased GH)

- Activation of the mTOR pathway, which is responsible for protein synthesis
- Inhibition of FOXO activation, which inhibits protein degradation
- Heat stress triggers a massive release of growth hormone



Muscular Benefits (Insulin Sensitivity)



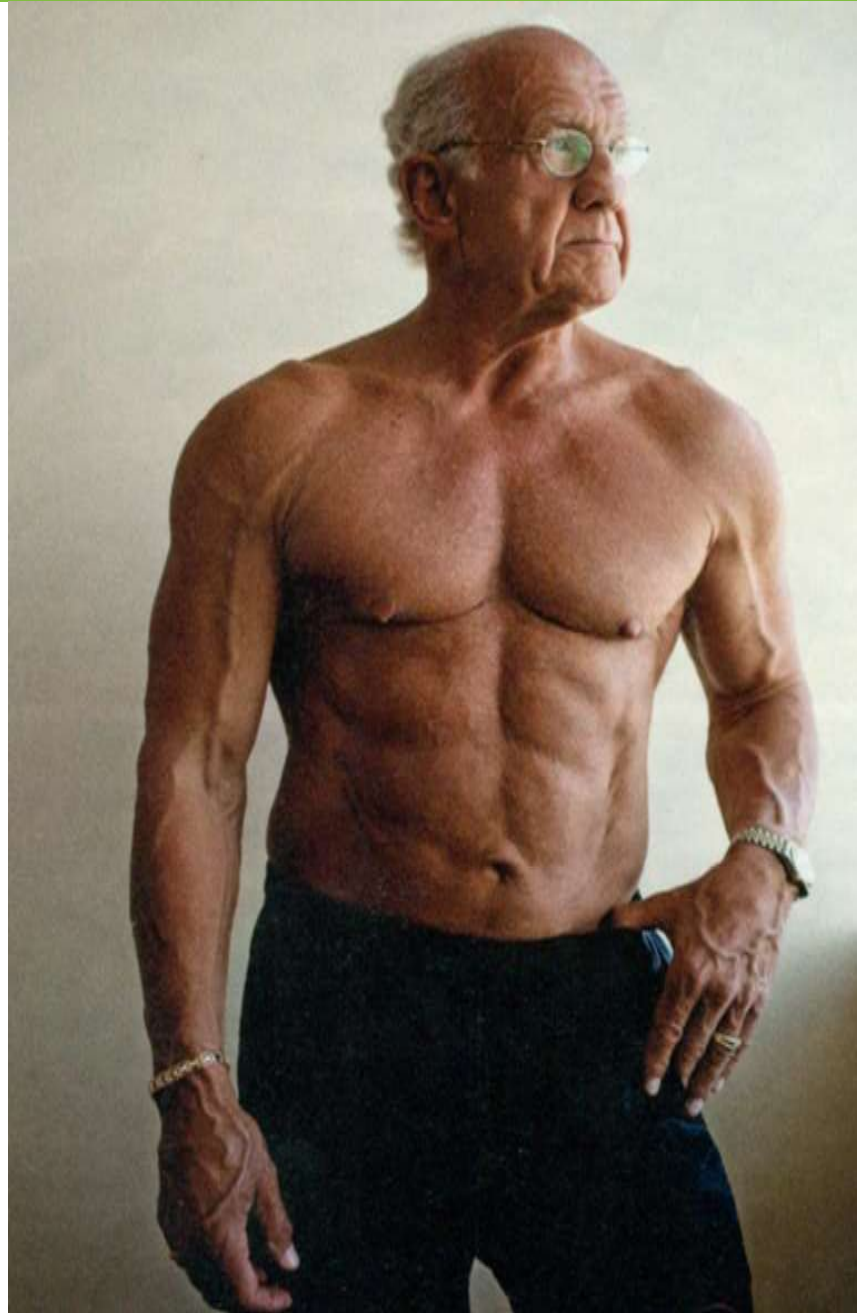
- Increases protein synthesis by stimulating the uptake of amino acids (particularly BCAAs) into skeletal muscle
- Decreases protein degradation through inhibition of the proteasome, which is a protein complex inside cells responsible for the degradation of most cellular proteins

Muscular Benefits (Injury Rehab)

- Muscle regrowth
- Delayed muscle atrophy



Longevity Benefits



Brain Benefits

- Activation of sympathetic nervous system
- Increased norepinephrine (focus/attention)
- Increased prolactin (myelin growth/nerve cell damage repair)
- Increased BDNF





Feel-Good Effect

- Increased dynorphin

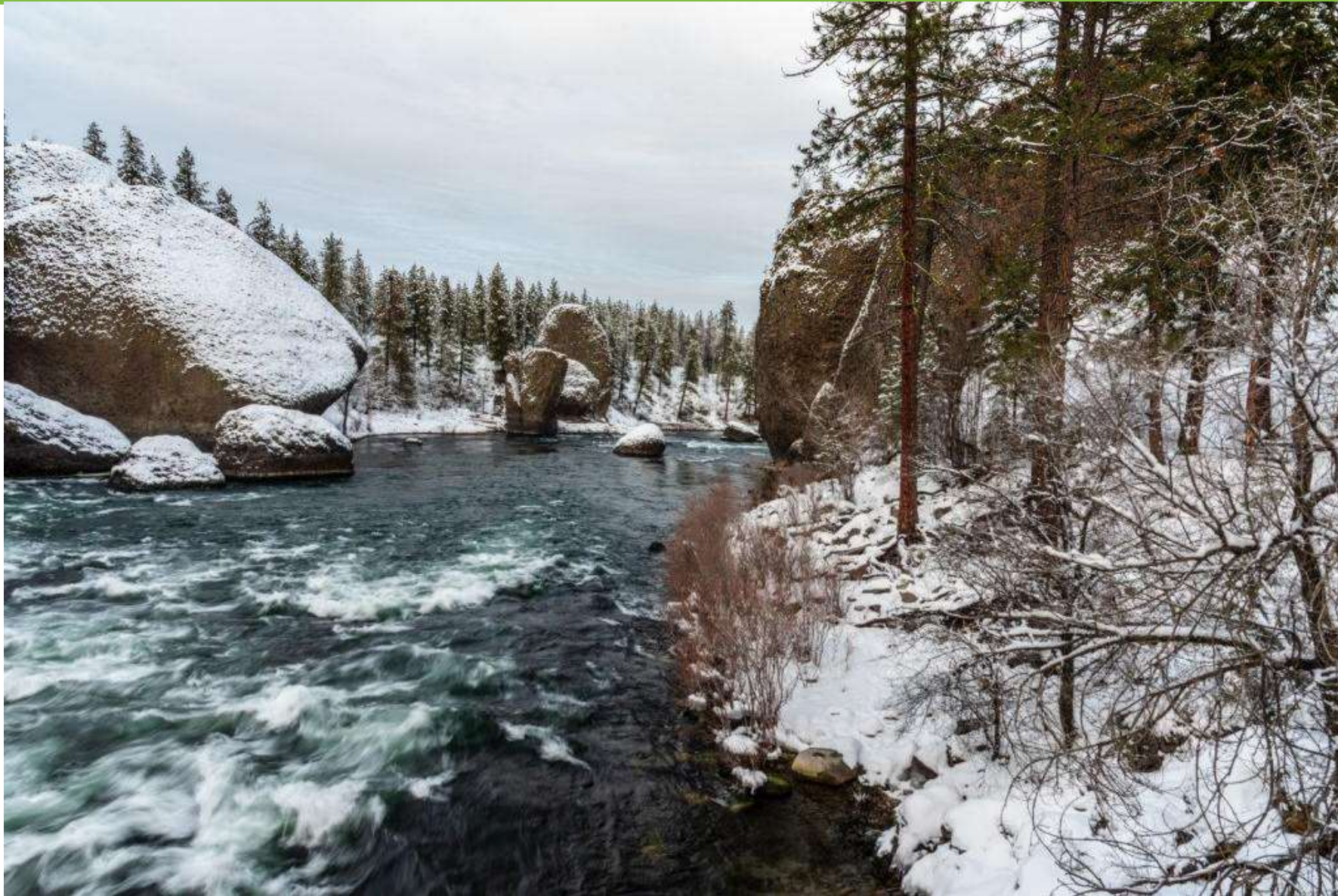
Quick Tips & Tricks

- Topical muscle warming cream (e.g. capsaicin topical, Prototype 8, etc.)
- Black pepper tea
- Niacin
- Activated charcoal
- Halotherapy
- Essential oils
- Quinton
- Caution re: neuromuscular recovery time



Ice





Brain Benefits

- Norepinephrine (decreased norepinephrine neurotransmission is associated with inattention, decreased focus and cognitive ability, low energy, and poor mood)
- Dopamine
- Decrease in serotonin inhibition via modulation of inflammation (more later)
- 1 hour at 57°F increases norepi by 530% and dopamine by 250%
- 40°F CWI for 20 seconds increases norepi 200 to 300%
- Synaptic regeneration (RBM3 cold shock protein increases protein synthesis at the dendrites)
- 41°F (5°C) for 45 minutes for synaptic regeneration in mice
- 2°F reduction in core body temperature is enough to induce cold shock proteins in humans - that's 1hr at 57-68°F in humans



Inflammation & Immune Benefits



- Norepinephrine inhibits the inflammatory pathway by decreasing TNF-alpha & macrophage inflammatory protein-1 α (MIP-1 α)
- Inhibition of collagenase activity on collagen (local cryo)
- Decreased production of inflammatory E2 series prostaglandins (local cryo)
- Increased antioxidants (cryotherapy for 3 minutes at -20°F for 20 days doubled the activity of glutathione reductase, and superoxide dismutase by ~43%)
- Cryotherapy (-24 to -28°F) 3 minutes a day for 10 days increased the activity of superoxide dismutase by 36% and glutathione peroxidase by 68%
- Increased lymphocyte numbers, including cytotoxic T lymphocytes
- Epidemiological studies on winter swimming show 40% decrease in respiratory tract infections

Weight Loss Benefits (Thermogenesis)

- Shivering thermogenesis via muscle contractions
- Non-shivering thermogenesis via norepinephrine induction of uncoupling protein 1 (UCP1) - mitochondria try to re-establish electrochemical gradient by transporting electrons derived from stored fat (fat oxidation) and produce heat as a byproduct of this process
- Increase in mitochondria “browns” white adipose tissue - even at 61F for 6 hours air temp
- Water: 68°F for one hour increases metabolic rate by 93% and 1 hour at 57°F increases metabolic rate by 350%





Performance & Recovery

- Anti-inflammatory response post-exercise peak at 1hr induces satellite cell migration, mitochondrial proliferation and IGF1 - don't blunt hormetic response (e.g. 3-8% drop in muscle temp=10 min CWI)
- Cryotherapy at -22 to -31°F 1 hour after plyometric exercise (squat jumps and leg curls) showed improvements in a variety of performance measures up to 72 hours after
- BUT men that performed leg presses and squat jumps 2x/wk and then immediately engaged in 10 minutes CWI had only 1/3 of the increases in muscle mass in their quadriceps and lower muscle strength 10 wks later compared to control
- Endurance? Cold exposure activates a gene called PGC-1 α , which makes more mitochondria in the muscle and shift to type I oxidative fibers
- 15 minute exposure to cold water (50°F) following running (NOT immediate post-exercise) increases PGC-1 α in muscle tissue

Performance & Recovery (continued)

- 15 minutes 3 times a week for four weeks after running increases mitochondrial biogenesis occurring in muscle tissue
- Runners - cryotherapy 3 min at -66°F performed 1 hour post-exercise and 24 hours post-exercise enhanced muscle recovery by decreasing inflammatory process (IL- 1β and C-RP) and increasing the anti-inflammatory process (IL-1ra)
- Runners - cryotherapy 1 hour, 24 hours, or 48 hours post hill sprint running - 20% increase in speed and power up to two days later
- Cyclists - 15 min CWI (59.5°F) 30 minutes post training 4 times per week had 4.4% increase in average sprint power, 3% enhancement in repeat cycling performance, and a 2.7% increased power
- Tennis players - cryotherapy (-184°F or -120°C) twice a day for 5 days - 2.5-fold decrease in the TNF-alpha and 23% increase in cytokine IL-6 and 4% increase in stroke effectiveness (norepi?) Note: they were ELITE
- FINALLY...Skeletal muscle cells from mice that have been engineered to have increased levels RBM3 have improved muscle cell survival, and even a larger muscle cell size after being exposed to cold shock



Tips & Tricks



- Cool Fat Burner
- Melatonin (brown fat thermogenesis)
- Caffeine (thermogenesis)
- Bitter Melon, Urolic Acid, polyphenols like Kaempferol & Oleuropein (increased UCP)
- Capsaicin, Piperine, Ginger, Cinnamon (capsaicin activates TRPV1 receptor, which releases noradrenaline, boosting thermogenesis in brown fat)
- P-Synephrine (from Citrus aurantium) - also noradrenaline effect
- Bile acids (upregulate thyroid hormone function, which boosts thermogenesis in brown fat)
- Forskolin (activates adenylyl cyclase in brown fat, resulting in higher cyclic AMP (cAMP))
- Fish oil (Increased metabolism in mice and reduced fat accumulation by 15 to 25%, and was via brown adipose tissue- mediated mechanism)
- Ketones (white to brown fat conversion)
- Breathwork (stay in longer/activate parasympathetic)
- Cryo vs. Cold Water Immersion? - comes down to:
 - 1) thermal conductivity; 2) surface area; 3) temp gradient
- Listen to [BenGreenfieldFitness.com/420](https://www.BenGreenfieldFitness.com/420)



**Want all resources, links & goodies
for this presentation?**

Visit BenGreenfieldFitness.com/pfx2020