Lighting for Breeding and Performance

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Overview

1) The properties of Light
2) Lighting for dry mares
3) Lighting for pregnant mares
4) Lighting for stallions
5) Lighting for performance

Light - Important Considerations..

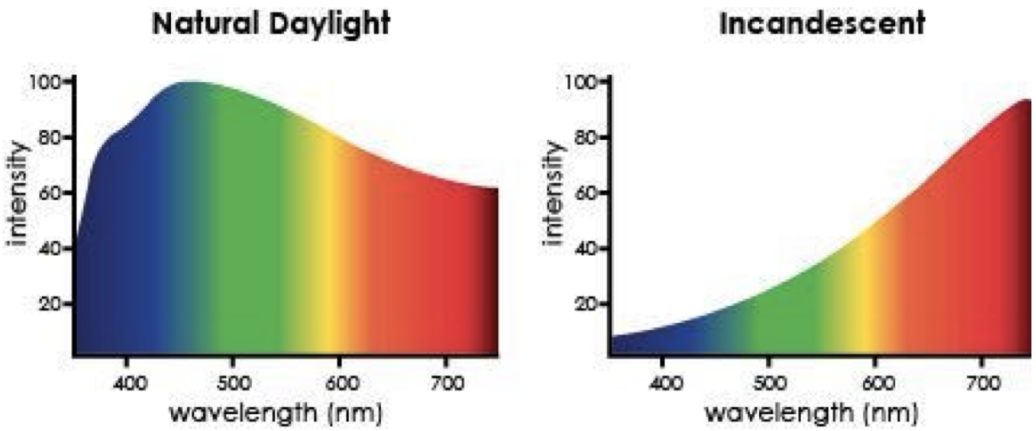
- The duration of daily light
- The quality of the light
- The consistency of the light -dark cycle

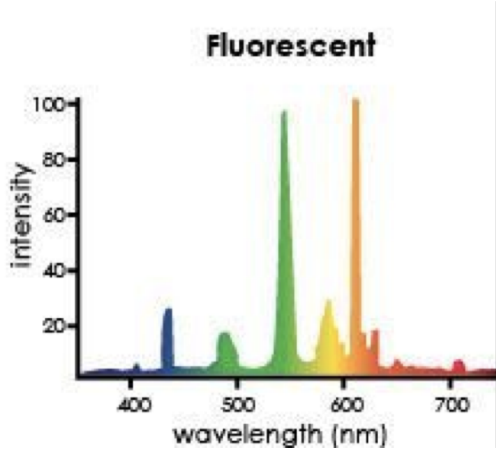
Horses (and humans) need light for more than just vision…

- Every cell in your body contains a clock
- The brain contains the 'master clock'
- Co-ordinates all bodily functions to 24 h (circadian), or 365 d (circannual) cycle
- Clock in brain must be reset to the correct time every day by LIGHT

HOW? **Receptors** in the eye are sensitive to **BLUE LIGHT**

Why Blue Light?

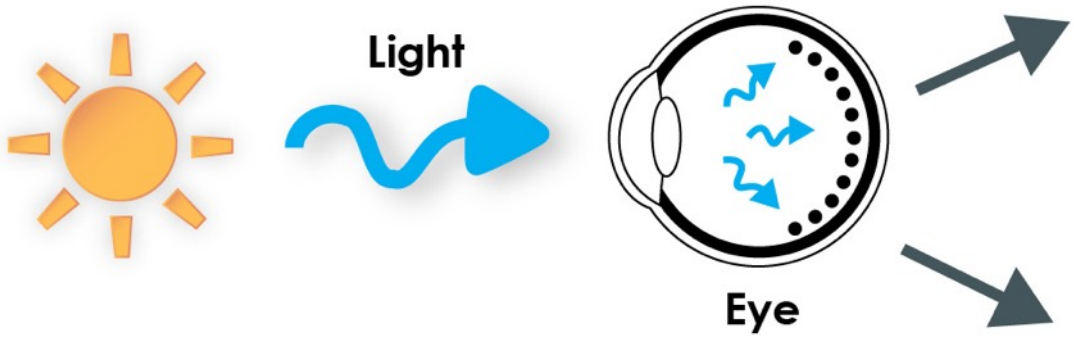




All Light is Not Equal

Light – For Vision & For Rhythm..

Light: An influential Environmental Agent



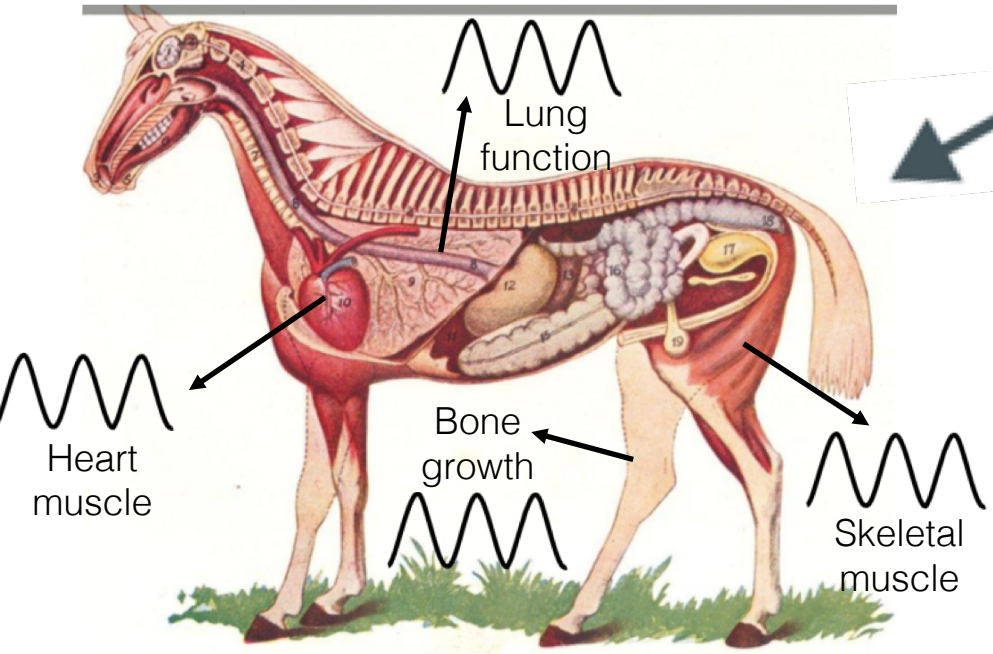
PRIMARY OPTIC TRACT

Visual effects
Visual reflects
Rods and cones

RETINOHYPOTHALAMIC TRACT

Circadian rhythms	Cirannual rhythms
Melatonin Secretion	Reporduction
Body Temperature	Growth
Cortisol Secretion	Metabolism
Heart Rate	Hair Coat
Alertness	Libido
Muscle function	Lactation
Gene expression	
Immune response	
Bloodflow	

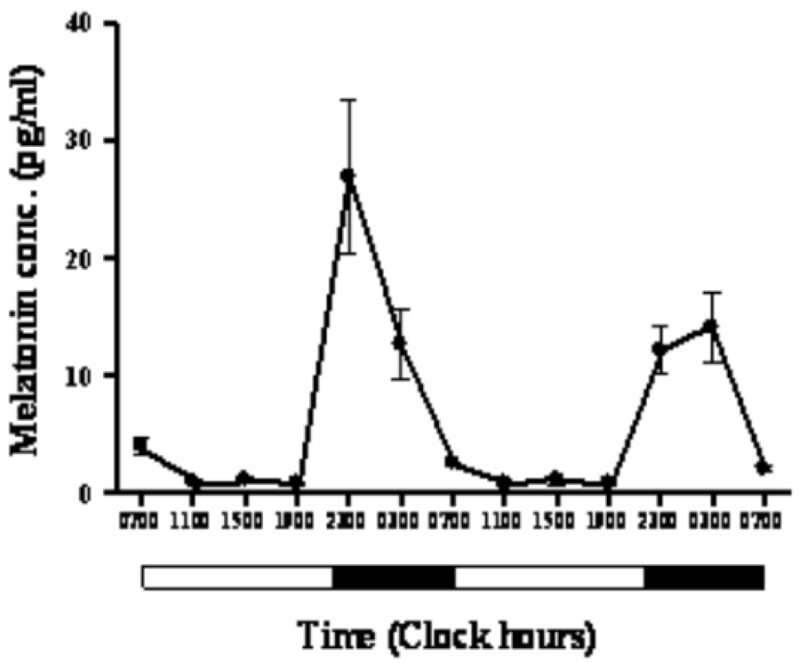
All regulated by intrinsically photosensitive retinal ganglion cells (ipRGCs)



The retino-hypothalamic tract is most sensitive to blue light stimulation

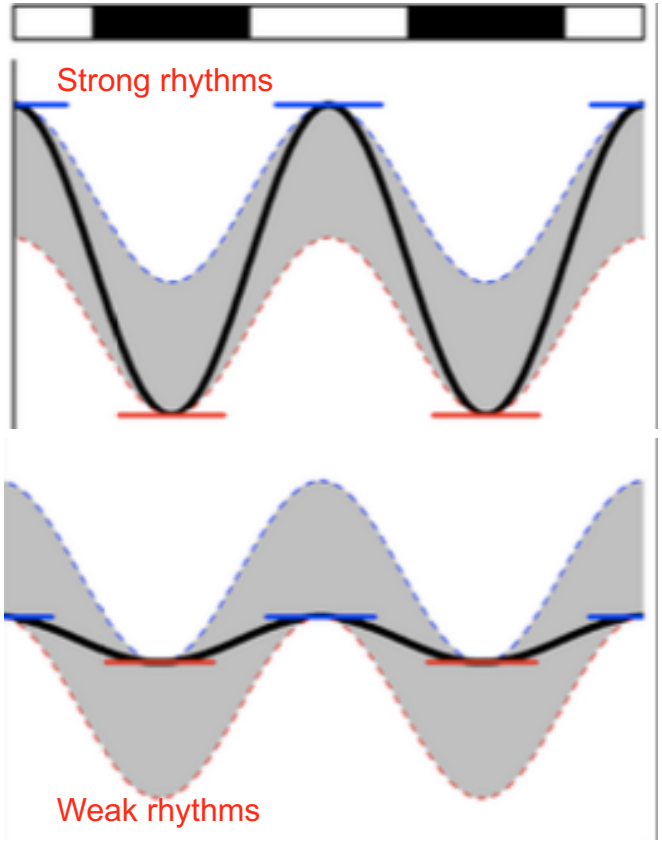
Rhythm of Melatonin

- Hormone of darkness, produced at night
- Suppressed by light, esp blue light
- Decoder of photoperiod
- Regulator of:
  - Rest/activity
  - Immune system
  - Reproduction
  - Mood
  - Weight



Murphy et al., 2006. Journal of Comparative Physiology A

- Good, regularly - timed light (high in blue)



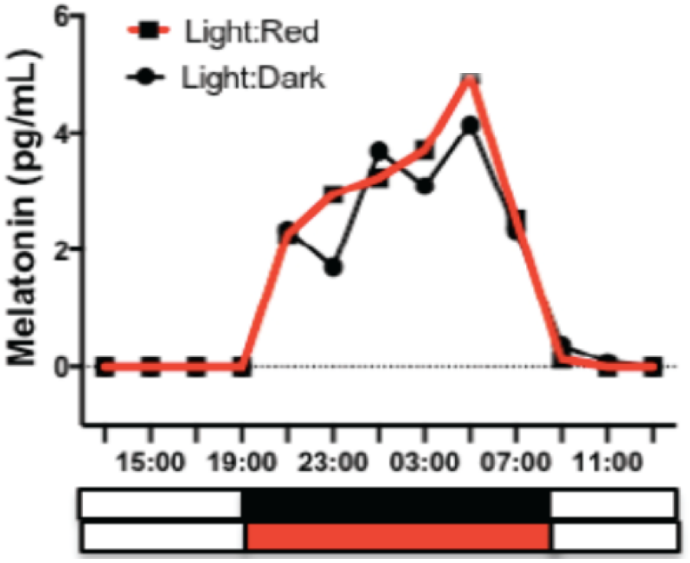
- Poor, irregular – timed light: (low in blue)

Optimal circadian lighting should provide:

- Blue enriched white light that mimics sunlight by day
- A regular and consistent transition to darkness or red light at dusk
- At least 6 h of undisturbed darkness or red light at night

Red Light at Night?

- Red light is invisible to the horse's circadian system
- Unlike white or blue light, it does not disrupt rhythms such as melatonin
- Facilitates night-time interactions and monitoring of horses
- Eliminates white light pollution at night
- Permits rest, recovery and relaxation at night



Murphy et al., 2018

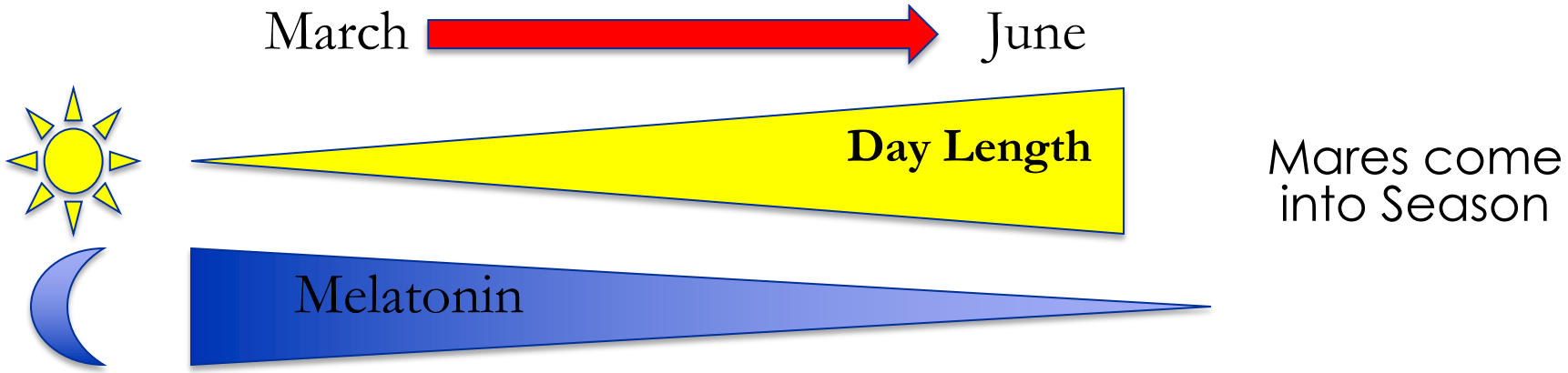
Lighting for the Dry Mare

- Horses are seasonal breeders
- Natural breeding season
  - April - Oct
- Light is key
- Increased day length stimulates reproduction

Light controls Melatonin… Melatonin controls reproduction

- Increasing daylength in the Spring

  ↓ Duration melatonin
  ↑ GnRH levels (Gonadotropin Releasing Hormone)
  ↑ Reproductive activity in mares



Inducing Early Cyclicity

- 70 days artificial lighting
  - NB average mare!
  - Beginning Nov 15th - Dec 1st
  - Provide 15-17 h light
- Feb 15th - breeding season begins
- Options
  - Stable lighting
  - Floodlit paddocks
  - Mobile headpiece
- Pros and cons to each

Lighting for the Pregnant Mare

- Extended daylength to pregnant mares influences:
  - Gestation length
  - Foal birth weight
  - Foal hair coat
  - Lactation
  - Post-foaling fertility

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Contents lists available at ScienceDirect

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ELSEVIER

Artificially extended photoperiod administered to pre-partum mares via blue light to a single eye: Observations on gestation length, foal birth weight and foal hair coat at birth

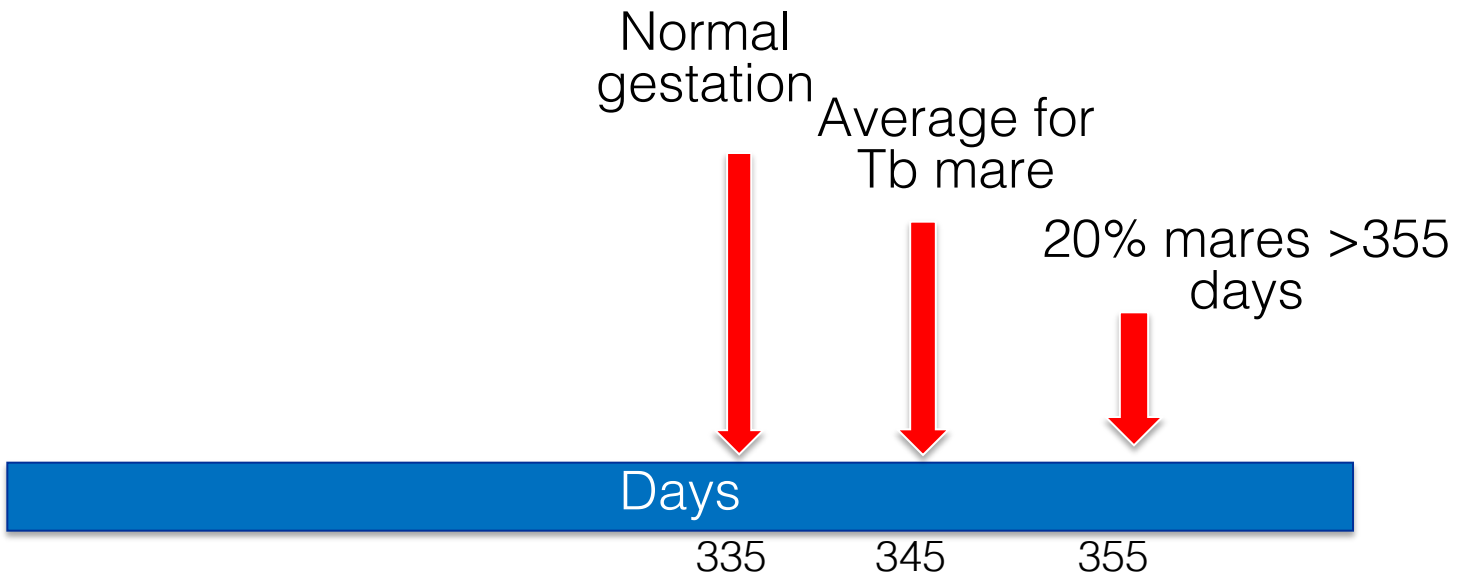
- If we shift the circannual lighting rhythm for dry mares, light should be returned to pregnant mares at the same time of year

- Most breeders do not maintain pregnant mares under lights from Dec 1st

  - High cost

  - Low awareness of benefits

Long gestations in Thoroughbreds



Long gestation

- reduced foal output

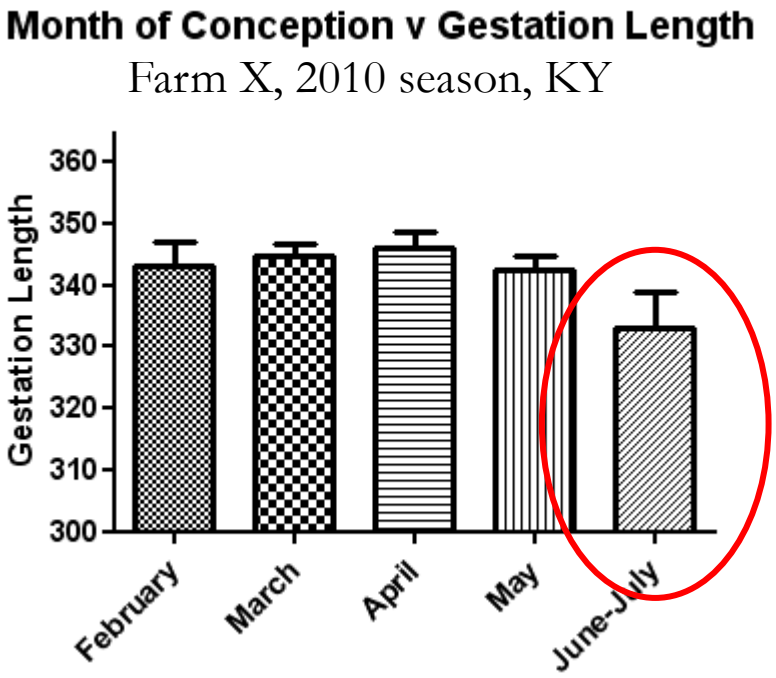
- financial loss

- foal complications

Gestation Lengths

Influenced by:

1. **LIGHT**
   - Prior to foaling
2. Maternal factors
3. Foetal factors



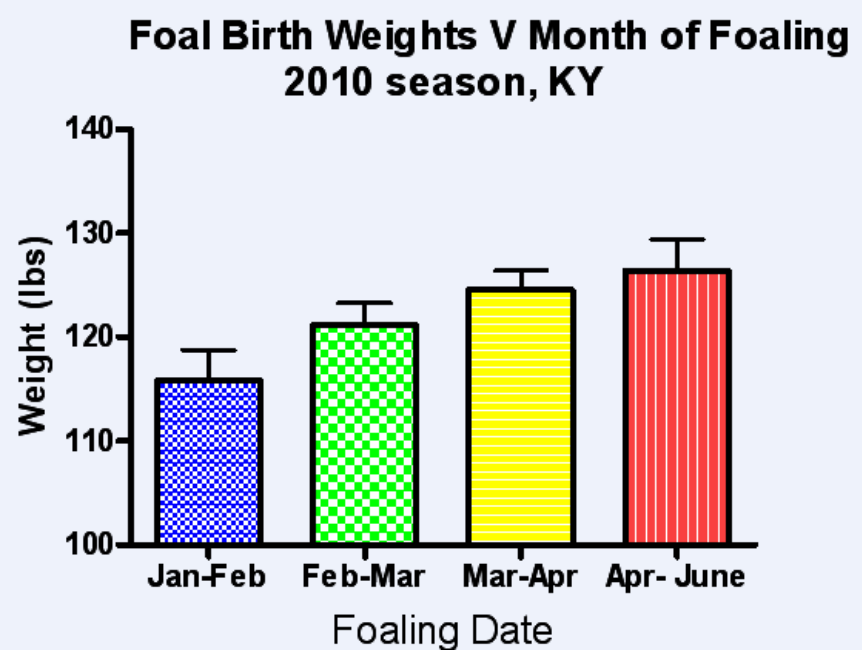
Mares that foal during the shorter days of winter/early spring have longer pregnancies

➡ Lack of sufficient light prior to foaling is the primary reason

Lower Foal Birth Weights occur earlier in the season

Foals born early in the year

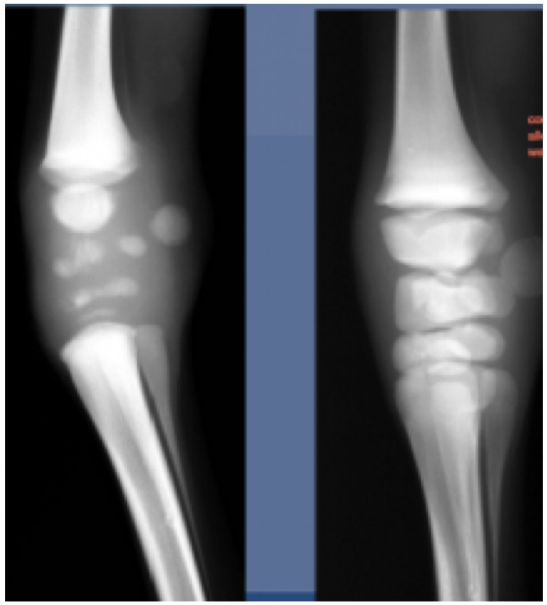
- Are Born Lighter



Why?- Mares foaling outside the natural season do not receive sufficient daylength to stimulate growth hormones

Other early foal problems?

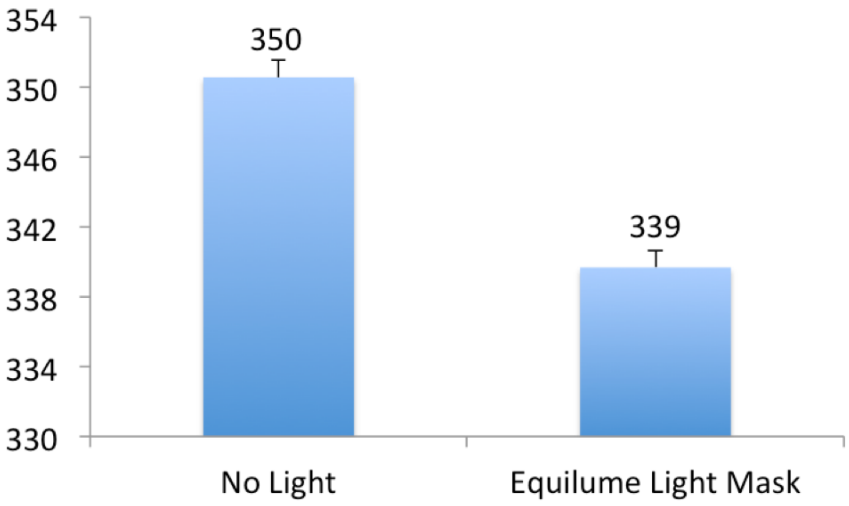
- Foals born early in the year
  - Often show signs of dysmaturity



- Why? – Early foaling mares do not receive the environmental signals that influence important growth hormones in circulation

Can light therapy influence gestation lengths? YES

Study: Mares with history of undesirably long gestations fitted with light masks on Dec 1st



Results: Gestation lengths shortened by 11 days *(Nolan et al., 2017)*

Can light therapy influence foal birth weight? YES

- Study: In collaboration with Gluck Equine Research Ctr.
- 30 pregnant mares all due to foal March
- All inseminated with same semen
- One group fitted with Light Masks on Dec 1st

Group	No. of Mares	Mean BW (lbs)	SEM
Light Mask	16	103.5	1.6
No Light	13	95.1	3.8
	Difference	*P = 0.039*	

- Mean body weight 8.4lbs heavier in mares wearing light masks (Nolan et al., 2017)

Other Benefits of Light for Pregnant Mares?

- Better post-foaling fertility
  - Eliminates 'lactational anoestrus'
- Farm feedback suggests improved colostrum
  - Higher IgG levels
  - Better foal immunity
- Ensures good milk production
  - Prolactin is a seasonally light-regulated hormone
  - Important for maidens

equilume performance lighting

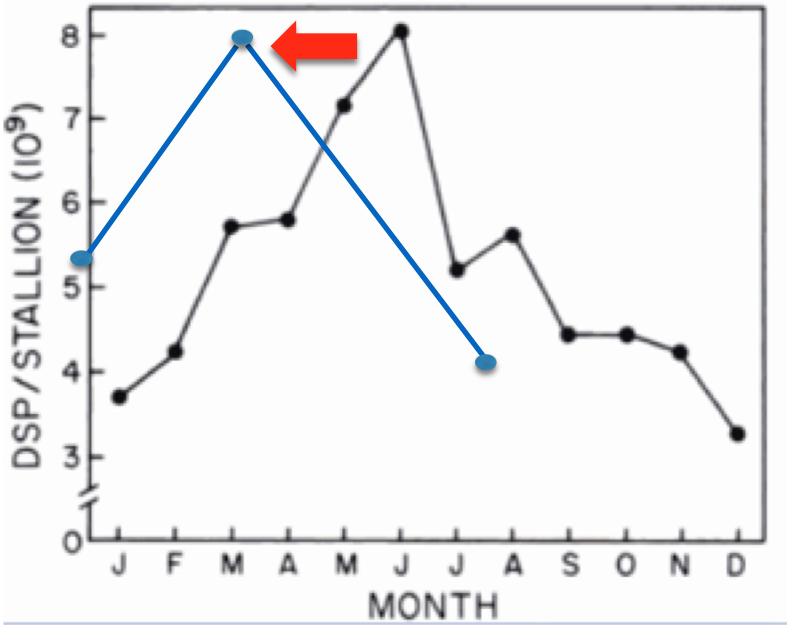
Two colts born on same day

Spot the difference?

IRISH NATIONAL STUD & GARDENS

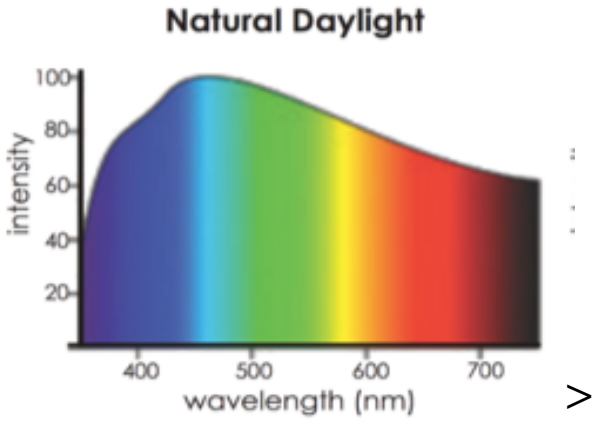
Lighting for Stallions

- Stallions are fertile all year, however….
- Daylength influences:
  - Testicular size
  - Semen volume
  - Sperm concentration
  - Daily sperm production
  - Mounts per ejaculate
  - Reaction time to the mare (libido)

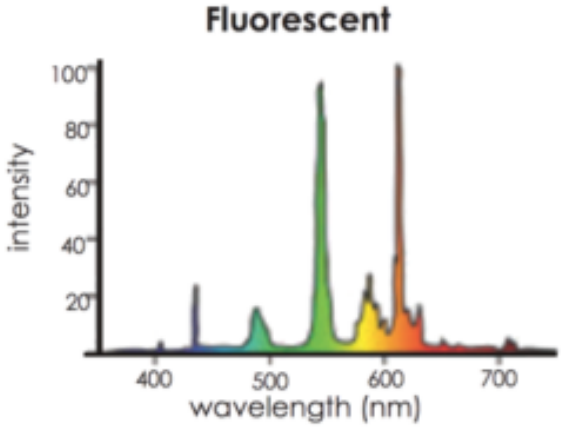


Light therapy (16h L: 8 h D) commencing in Dec will advance the timing of peak stallion fertility. (Pickett et al., 1989; Clay et al.,1987)

Lighting for Horses in Training



>5,000 lux



<50 lux

The average Thoroughbred in training spends up to 23 hours per day in a poorly lit stable

Lighting for Horses in Training

- Both the circadian and circannual functions of light need to be considered for the stabled performance horse
- To optimise:
  - Health
  - Performance
  - Welfare

Equilume Stable Light

The Aims:

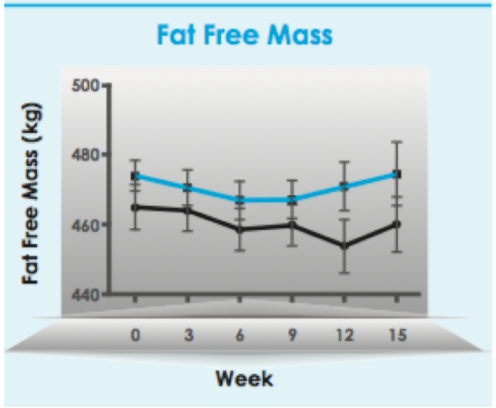
1) Mimic the qualities of natural environmental light for the stabled horse
2) Strengthen inernal rhythms
3) Advance and extend the circannual season of peak performance

Study 1
2-Yr old Thoroughbreds in training

- Single white LED by day, red LED by night, gradual transitions
- 56 2-yr olds at pre-training yard in Co Tipperary
- LED lighting installed over 23
- Traditional fluorescent lights over 23
- Body composition monitored for 15 weeks
- Environmental samples collected
- January – April 2016, Ireland

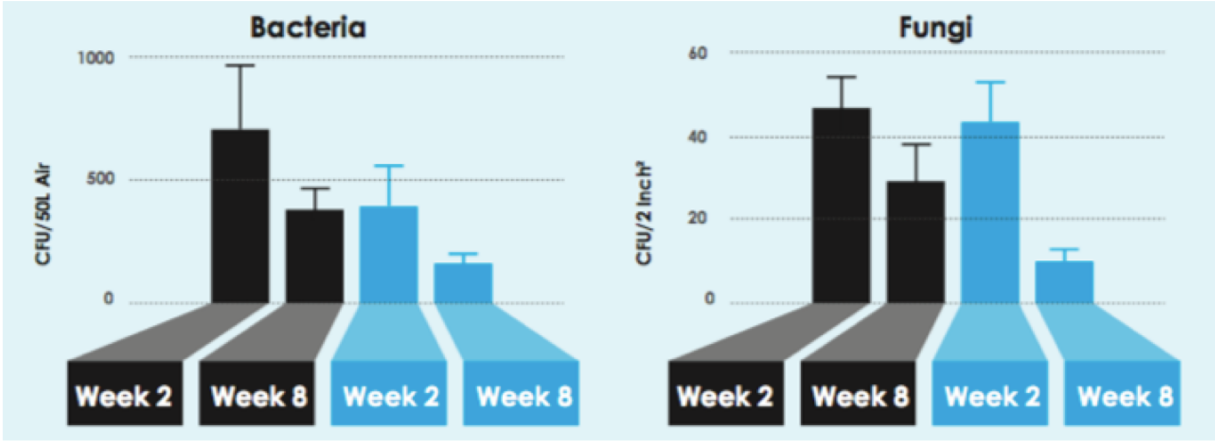
Results

- Horses maintained under the LED Lighting system were significantly heavier with a higher Fat Free Mass than control horses after 15 weeks *(P<0.01)*
- There was 32 Lbs. average difference in muscle mass between the groups
- Fat Free Mass is directly correlated with aerobic capacity and performance



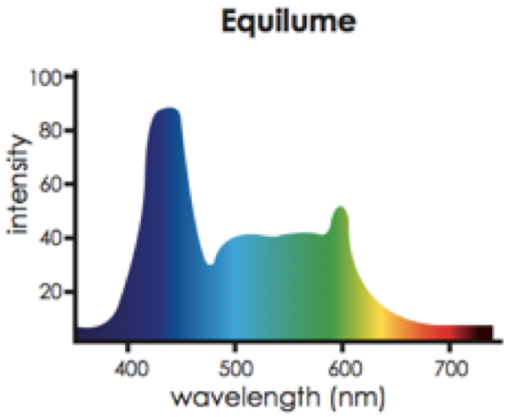
Results

- Airborne and surface microbes were reduced in stables with the new lighting system, especially after 8 weeks
- Blue light inhibits microbial growth, similar to sunlight



Study 2:
2, 3 and 4-Yr olds in training

- Multi- colour LED array prototype, enriched in blue spectrum by day, red LED by night, gradual transitions
- 50 2-yr horses in training on the Curragh
- LED lighting installed over 25
- Traditional fluorescent lights over 25
- Body composition monitored for 15 weeks
- January – May 2017



Professor John Sheridan BE, MSc EE, Dphil
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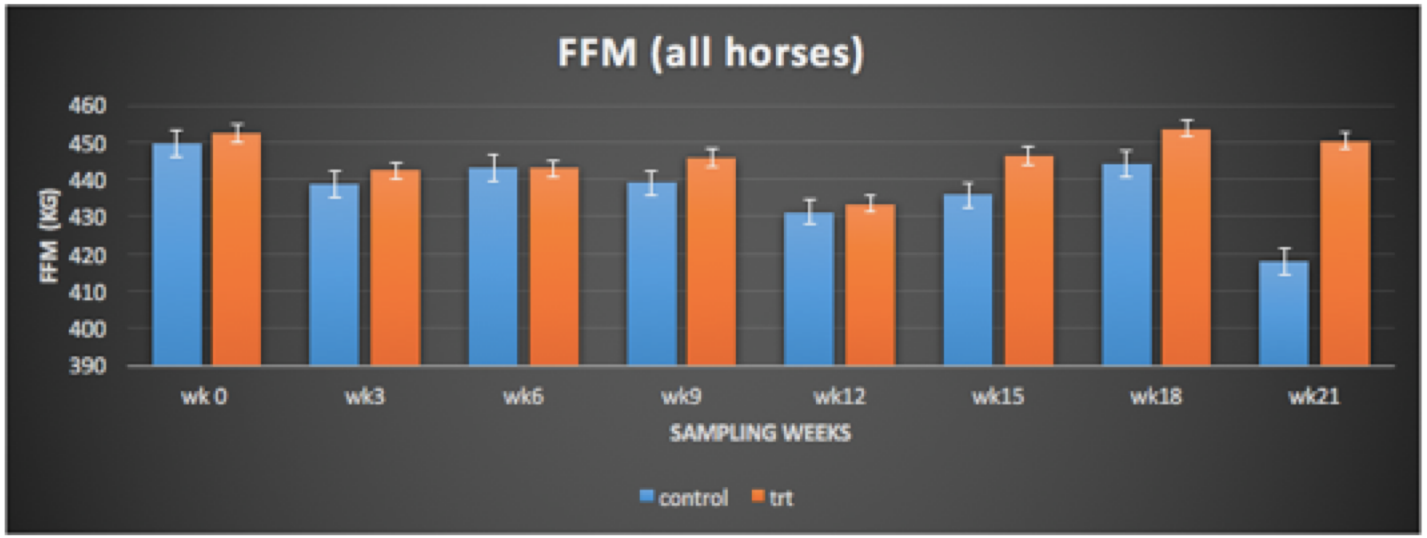
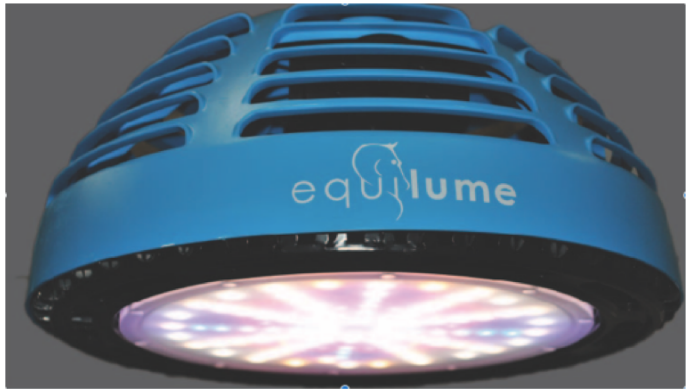
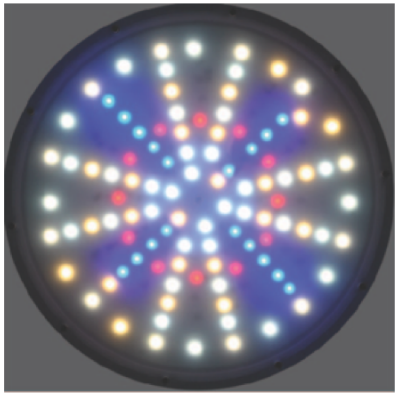
Co-Founder, Equilume

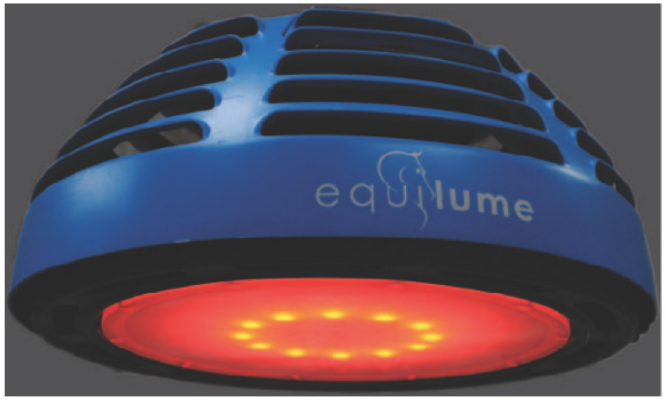
Study 2 – 2, 3 & 4 yr olds



All Horse:Trt*Wk *P*=0.007 significant
Males:Trt*Wk *P*=0.0380 significant







The Equilume Stable Light provides:

- Blue enriched white light that mimics sunlight by day
- A regular and consistent transition to darkness or red light at dusk
- At least 6 h of undisturbed darkness or red light at night
- Circannual function that extends season of peak performance
- Simple, user-friendly control system

Feedback from early adopters

- *Picky eaters eating up*
- *Bedding less disturbed in morning*
- *Youngsters more alert in morning*
- *Lying down more at night*
- *Coats amazing*
- *Wounds heal faster*
- *Ringworm cleared up fast*
- *Topline maintained on box rest*