



Impact of Light on Poultry

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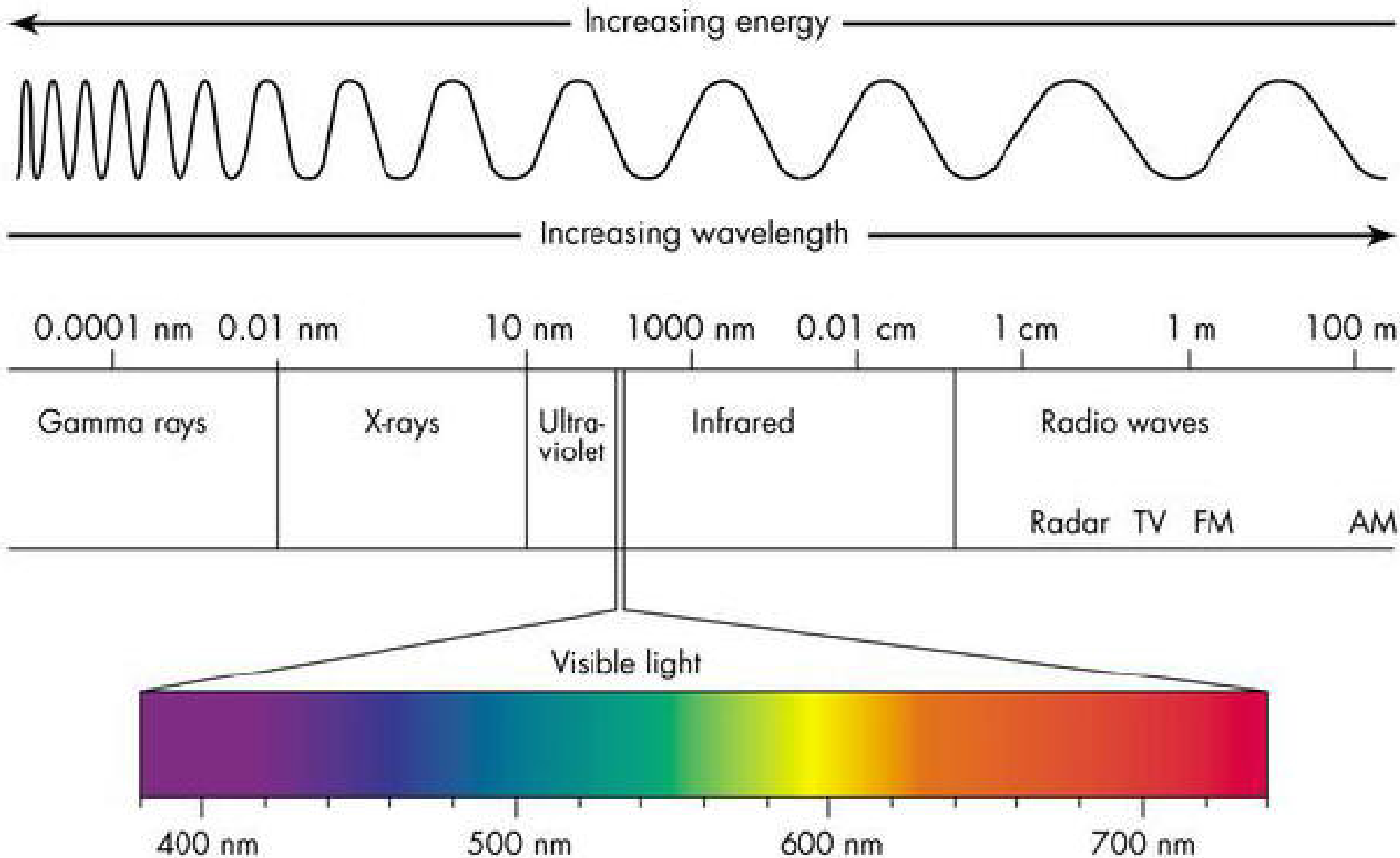
Introduction

- What is light?
- Impact of lighting on raising poultry
 - Impacts biological rhythms
 - Impacts physiology: growth, behavior & reproduction
- Important light/lighting characteristics
 - Color
 - Brightness
 - Duration

Light

- Electromagnetic waves (radiation)
 - Visible light small part of full light spectrum
- Visible light (optical radiation)
 - ~380 – 780 nanometers (nm)
 - Differently perceived by humans and chickens

Electromagnetic Spectrum



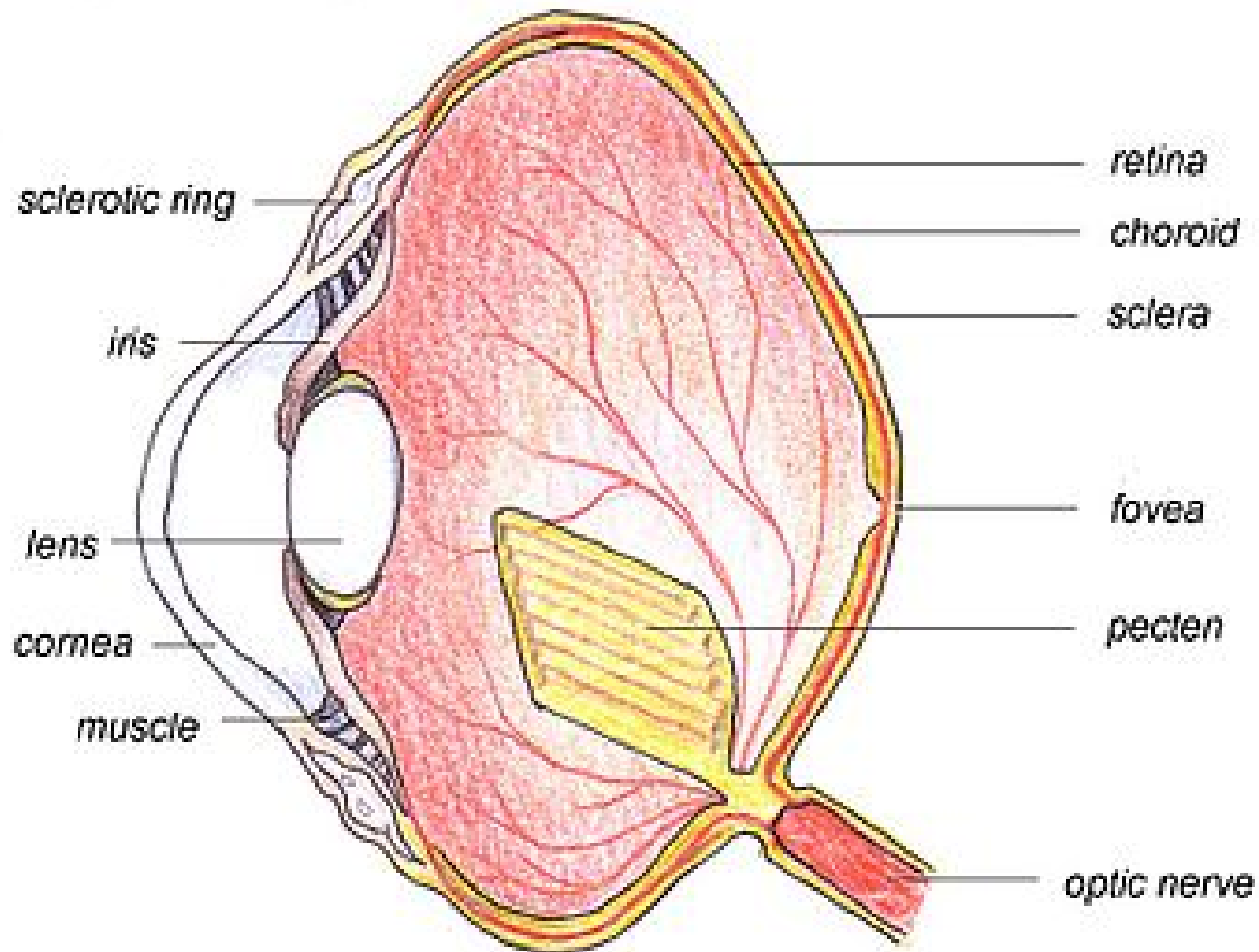
How Chickens “See” Light

- Two main ways light signals the brain in birds
 - Eyes
 - Extra-retinal receptors = important endocrine glands
(glands that secrete hormones directly into the blood)

Avian Vision

- Chickens have large, highly sensitive eyes
- Flattened shape of eyes increase visual acuity
- Birds have a higher sensitivity than humans
- Rods and cones are structures found in retina
 - More rods than cones = low light vision
 - Cones used for daylight & color vision

The Avian Eye

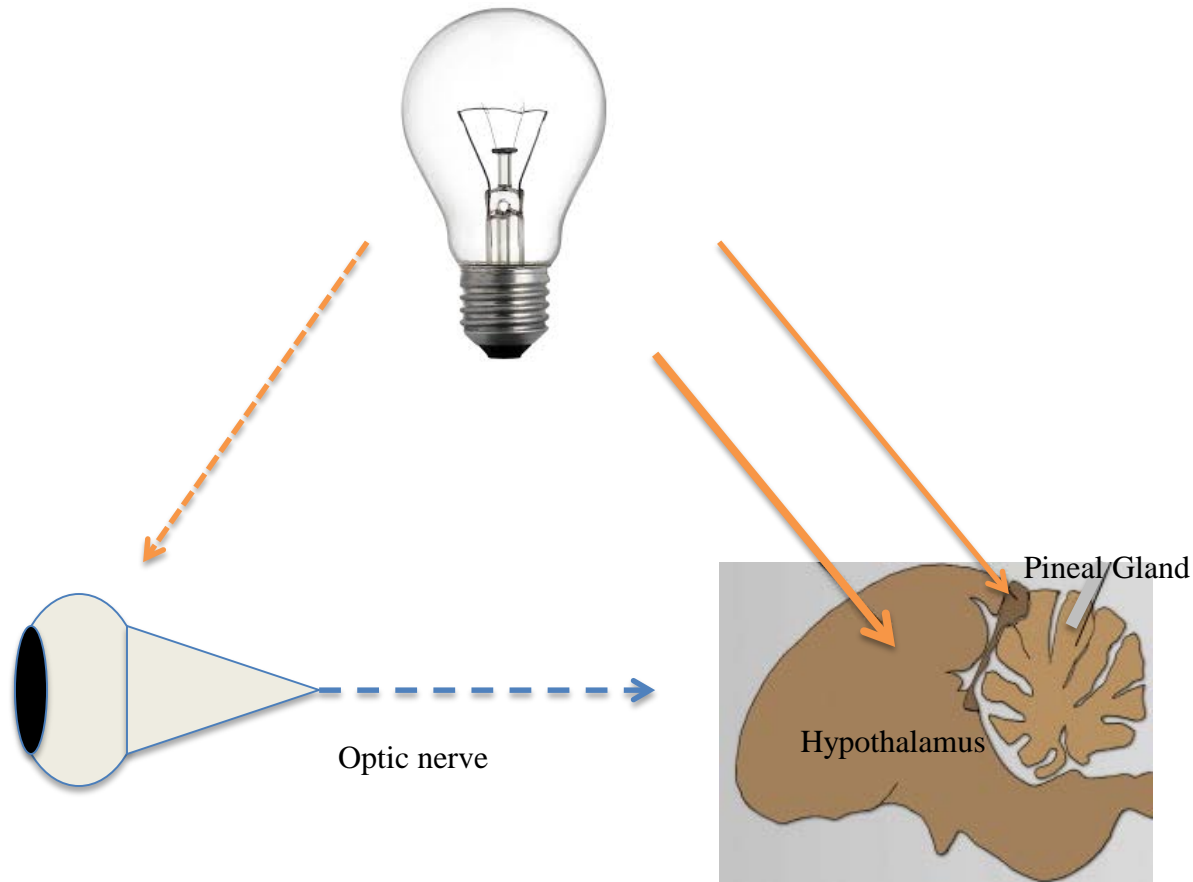


Extra-Retinal Light Receptors

Endocrine Glands

- Pineal Gland
- Hypothalamus
- Effect Behavior, Growth & Reproduction

Light Reception



**Pathways of Light Reception Effecting
Endocrine System**

Endocrine Glands

- Light penetrates through the top of skull & stimulates pineal gland & hypothalamus
- Pineal gland light's sensitivity is used to regulate
 - Daily behavior cycles
- Hypothalamus
 - Regulates broiler metabolism & reproduction

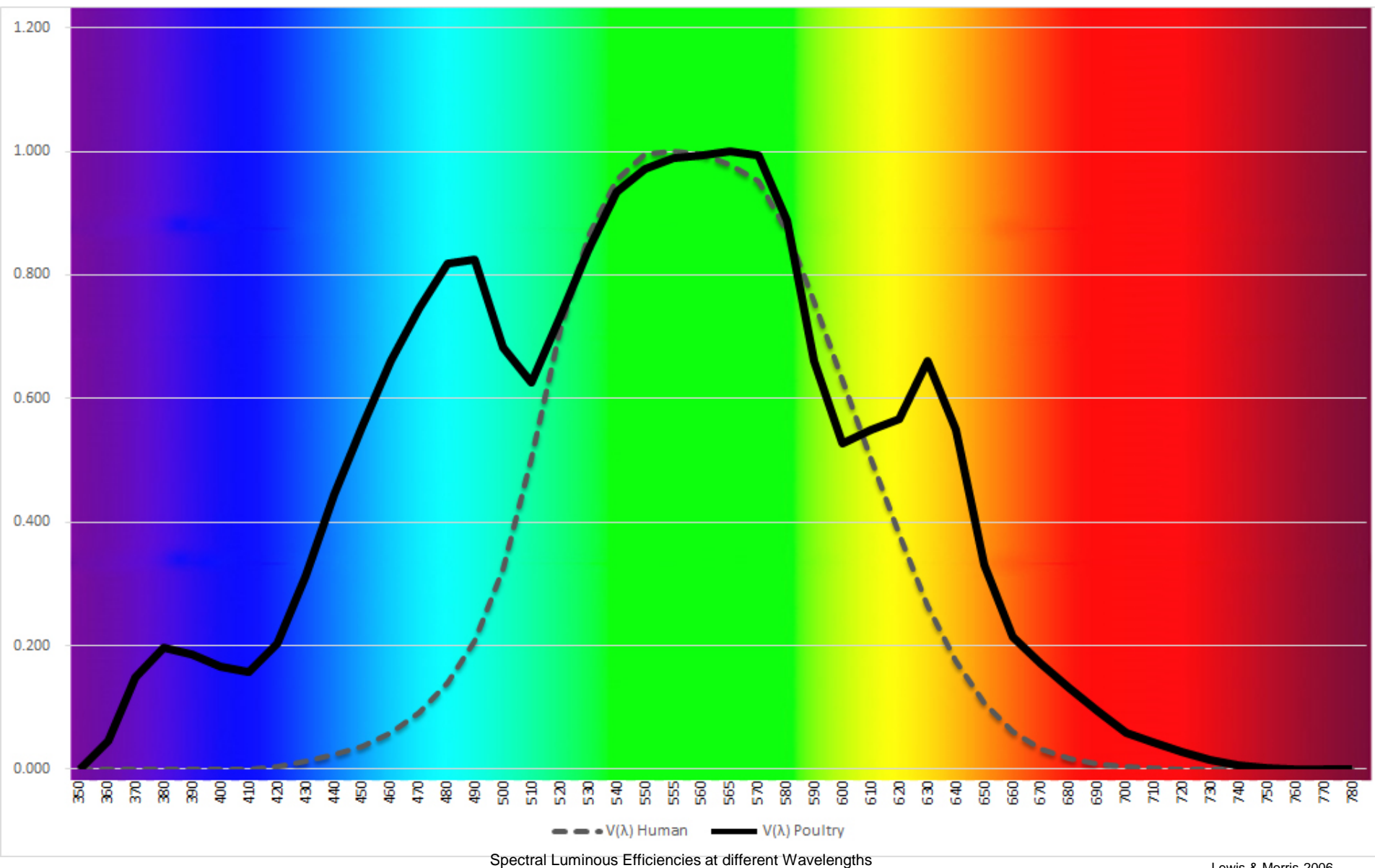
Important Light Characteristics

- Color (wavelength)
- Brightness (intensity)
- Duration (photoperiod)

Color of Light

- Color = wavelength of light
- Poultry have different sensitivity to different colors
 - Poultry perceive light & color differently than humans
 - Unlike humans, birds are sensitive to ultra violet (UV) light
 - Poultry have greater sensitivity to multiple regions of visible light
 - **Therefore perceive light from some bulbs as brighter than other bulbs (of same lumens), and more intensely than humans**

Human-Chicken Visible Spectrum



Impact of Color on Broilers

- Studies using monochromatic light demonstrated superior growth for broilers given blue or green light
 - Some studies suggest broilers are less active under blue or green light than under red or white light
 - Yellow-red color may ↑ activity
- Field performance under different commercial colored lamps have not yielded significant differences yet
 - 2700-3000 vs 4000-5000 K lamps continue to be tested but no clear winners
 - Still opportunities for improvement = LEDs and dimming

Brightness = Intensity

- Foot candles (fc) or lux ($1 \text{ lx} = 0.09 \text{ fc}$)
- Lumen = std. measure of light bulb outputs
- On average, chicken (37%), duck (30%), and turkey (16%) more sensitive to light than in humans

Light Intensity

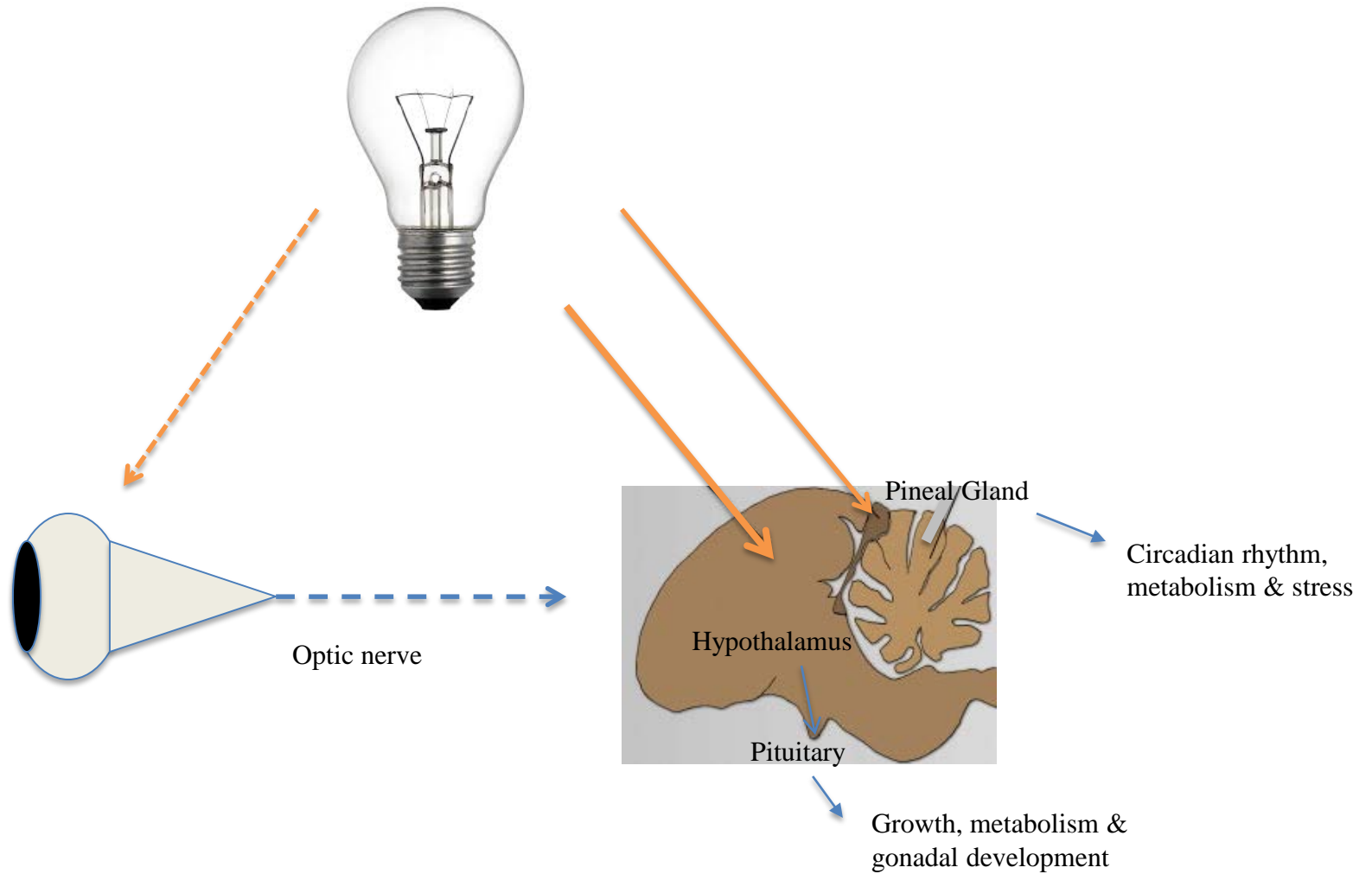
Impacts rhythms of feeding behavior

- Higher levels are used to stimulate chicks to be more active, eat and drink more after placement
- Minimum level required to:
 - Stimulate pineal gland & hypothalamus
 - Consideration for growers working in houses

Endocrine Light Stimulation

- Light intensity must be strong enough to penetrate skull & cranial tissues to reach pineal gland & hypothalamus
 - primarily by longer wavelengths = orange-red
 - large proportion of full-spectrum white light/incandescent output
 - retinal tissue in the eye plays important role in circadian rhythm
 - allows feedback at very low light levels (~0.1-.3 fc)

Light Stimulation



Pineal Gland

Presence or absence of light utilized by pineal to:

- Function as pacemaker for circadian rhythm
 - 24 hour cycle = active day & inactive night
- Controls melatonin hormone = dark regulated
 - Impacts night time body temperature
 - Involved in sleep regulation
 - May impact stress levels & immunity

Minimum Light Intensities

- Research indicates there are minimum thresholds for light intensity
- Management/performance guides recommend
 - 2-5 ftc (20-55 lx) for starting chicks
 - gradually reducing down to 0.1 fc (1 lx) for older broilers
 - table egg layers require 0.5-1 fc (5-10 lx)
 - broiler breeders require 1.5-4 fc (17-45 lx) for fertile egg production
- Uniform light pattern important when choosing bulb design

Duration = Photoperiod

- Period of illumination = day length/artificial lighting
 - Daily light/darkness cycle strongest environmental stimulus for timing of behavior
 - Impacting feeding, drinking & sleep behavior
- Impacts hypothalamus
- Lighting programs can impact broiler performance

Hypothalamus

- Sensitive to photoperiod
- Regulates pituitary gland which regulates
 - Growth hormone
 - Thyroid: key controller of metabolism & body temperature
 - Gonadal development = egg & sperm production
 - Chickens are long day breeders

Broiler Lighting Programs

- Conventional = continuous or near-continuous 23L:1D
 - Studies showed heritage lines of broilers responded \uparrow growth
 - Modern strains respond differently = \downarrow growth
- Short daylength followed by long day
 - 6L:19D to 21 days; 23L:1D remainder
 - Better liveability and feed efficiency
- Intermittent = multiple cycles of 1L:3D, 2L:4D
 - Better feed efficiency, reduced activity
 - Suggested better use of nutrients because more “meal-feeding”

Commercial programs combine photoperiod & dimming

Impact of Different Lighting Programs

Characteristic	Conventional 23L:1D*	Short Day 6L to 21 days 23L at 22 days to market*	Intermittent*
Feed Intake	100	98	96
Body Weight	100	100	101
Feed Efficiency**	100	102	106
Liveability	100	105	100
Leg problems	-	Reduced	same
Ascites	-	Same	reduced
Electricity savings	-	yes	yes
Light proofing house recomended	-	yes	preferred

*No dimming (no change in light intensity)

**Higher feed efficiency = lower feed conversion

Summary

Combining lighting characteristics = greater impact

- Lighting programs combine photoperiod & dimming (intensity) to impact broiler behavior, performance & welfare
- Impact of color still being studied
- When purchasing bulbs consider
 - Need minimum output levels & uniformity
 - Dimming performance

Questions?



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