Lighting Poultry:
What is Light
What do Poultry Need
Incandescant vs UV vs LED

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Why Lights for Chickens?

1. to facilitate sight,
2. to stimulate internal cycles due to day-length changes, and
3. to initiate hormone release
WHAT IS LIGHT?

- WAVELENGTH
- INTENSITY
- DURATION

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INTENSITY

1 FOOT CANDLE = 10.76 LUX

A LUMEN is equal to one foot-candle falling on one square foot of area.

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Candlepower is a rating of light output at the source, using English measurements.

Foot-candles are a measurement of light at an illuminated object.

Lumens are a metric equivalent to foot-candles in that they are measured at an object you want to illuminate.

Divide the number of lumens you have produced, or are capable of producing, by 12.57 and you get the candlepower equivalent of that light source.

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Light Intensity and Bird Behavior

0.2 fc - eating

0.3 fc - fighting

0.5 fc - egg production

0.5 - 5 fc is usually OK
if you exceed 10 fc you may see behavior problems

INTENSITY, continued

Black Out Housing

day 1-3 use 1 - 2 fc

day 4 - processing use .5 - 1 fc

Window House

Use .5 - 5 fc, depending
INTENSITY, CONTINUED

In natural light housing (window or curtain) then the natural light is supplemented with 1.5 - 5.0 fc for the period when supplemental lighting is used. (i.e. to provide up to 16 hrs of light per day.

For commercial egg layers, a minimum of 0.5 fc is required for egg production.

Solar spectral distribution entering the lower parts of the atmosphere.
WAVELENGTH

<table>
<thead>
<tr>
<th>Wave</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>UV</td>
<td>&lt; 380 nm</td>
</tr>
<tr>
<td>VIOLET</td>
<td>380 - 450 nm</td>
</tr>
<tr>
<td>BLUE</td>
<td>451 - 490 nm</td>
</tr>
<tr>
<td>GREEN</td>
<td>491 - 560 nm</td>
</tr>
<tr>
<td>YELLOW</td>
<td>561 - 590 nm</td>
</tr>
<tr>
<td>ORANGE</td>
<td>591 - 630 nm</td>
</tr>
<tr>
<td>RED</td>
<td>631 - 760 nm</td>
</tr>
<tr>
<td>INFRARED</td>
<td>&gt; 761 nm</td>
</tr>
</tbody>
</table>

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CHROMATICITY

WARMTH OR COOLNESS OF LIGHT
EXPRESSED IN DEGREES KELVIN
(real used for incandescent lamps)

> 4000 K = Cool (more blue light)
3500 to 3600 K = Balanced, neutral
< 3000 K = Warm (more red light)

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So, why do we measure the hue of the light as a "temperature"?

This was started in the late 1800s, when the British physicist William Thomson (the 1st Baron Kelvin) heated a block of carbon. It glowed in the heat, producing a range of different colors at different temperatures.

The black cube first produced a dim red light, increasing to a brighter yellow as the temperature went up, and eventually produced a bright blue-white glow at the highest temperatures.

In his honor, Color Temperatures are reported as Kelvin.
Comparison of Different color Temperatures of Lamps.

The lower the number
The more RED in the light
The higher the number the more BLUE

What do birds see?

Human and Poultry Spectral Sensitivity
How does color affect the bird?

BLUE - GREEN = GROWTH

ORANGE - RED = REPRODUCTION
**Incandescent Bulbs**

- Low initial cost
- Variety in size and base type
- Can be dimmed
- Low life
- Can run hot—Good in cold weather

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**Fluorescent**

- Standard Ballast
- Compact (CFL)
- Cold Cathode (CCL)
- Highly Efficient—CCL 25k hours +
- Many Colors
- Not all are dimmable
- Require ballasts
### Conversions from INC to CFL

<table>
<thead>
<tr>
<th>Range</th>
<th>Incandescent Watts</th>
<th>CFL Watt range</th>
<th>Lumen</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>8 - 10</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>15 - 18</td>
<td>890</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>18 - 22</td>
<td>1210</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>23 - 28</td>
<td>1750</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>34 - 42</td>
<td>2780</td>
<td></td>
</tr>
</tbody>
</table>

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### Cold Cathode Lamps

- Very Long Lasting 25,000+ hrs
- Dimmable versions
- Up to 709 lumens per linear foot
- Many color outputs available
- Ballast required – variable voltage
- Limited use thus far, but seems positive

These cold cathode lamps are a cost effective alternative to CFL or LED

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### Incandescent, Compact Fluorescent, LED
Light Emitting Diodes (LED)

- Can be of most any size
- Run cold
- Started use in computer industry
- Higher output diodes are being developed.
- Lower throws from some sources.

Here are some unique LED characteristics:
Directional light emission – directing light where it is needed.
Size advantage – can be very compact and low-profile.
Breakage resistance – no breakable glass or filaments.
Cold temperature operation – performance improves in the cold.
Instant on – require no “warm up” time.
Rapid cycling capability – lifetime not affected by frequent switching.
Controllability – compatible with electronic controls to change light
levels and color characteristics.
- No IR or UV emissions - LEDs intended for lighting do not emit infrared or ultraviolet radiation.

How a LED lamp works:
How are white LEDs created?

There are currently two ways to make white light with LEDs. One method mixes multiple wavelengths of different LEDs to make white light (i.e. RGB), allowing the lighting designer to tune the white light to a specific color temperature.

The second method uses a blue Indium-Gallium-Nitride (InGaN) LED with a phosphor coating to create white light. This is the method that results in the more commonly seen “white LED”.

When designed properly, an LED circuit will approach 80% efficiency, which means 80% of the electrical energy is converted to light energy.

<table>
<thead>
<tr>
<th>Light Source</th>
<th>Range of Typical Rated Life (hours)*</th>
<th>Estimated Useful Life ($L_{70}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incandescent</td>
<td>750-2,000</td>
<td></td>
</tr>
<tr>
<td>Halogen incandescent</td>
<td>3,000-4,000</td>
<td></td>
</tr>
<tr>
<td>Compact fluorescent (CFL)</td>
<td>8,000-10,000</td>
<td></td>
</tr>
<tr>
<td>Metal halide</td>
<td>7,500-20,000</td>
<td></td>
</tr>
<tr>
<td>Linear fluorescent</td>
<td>20,000-30,000</td>
<td></td>
</tr>
<tr>
<td>High-Power White LED</td>
<td>35,000-50,000</td>
<td></td>
</tr>
</tbody>
</table>

It is important to note that the delivery of light from an LED varies from how all other more familiar lamps deliver it. The LED directs the light at smaller angles, of 120 degrees or less whereas the more familiar incandescent (or CFL) would be at 360 degrees.

For most producers/integrators that have been accustomed to this 360 degree light, the visual of directed LED will be different. It makes the rest of the room seem darker, but brighter under the focused lamp.
What's the difference between *efficiency* and *efficacy*?

**Efficacy** is a term normally used in cases where the input and output units differ. In lighting, we are concerned with the amount of light (in lumens) produced by a certain amount of electricity (in watts).

On the other hand, *efficiency* is a term that is typically dimensionless. For example, lighting fixture *efficiency* is the ratio of the total lumens exiting the fixture to the total lumens initially produced by the light source.

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Philips 22 watt LED tube lamp  To replace fluorescent lamps.

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Poultry LED AgLed lamp  Next Gen Illuminations

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Dimmable LED Poultry Lighting System  Sunlite Science & Technology, Inc.

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Agrishift AC LED’s from ONCE Innovations, Inc.

UConn study by Mike Darre looking at LED lamps placed on top of each cage in a cage layer facility. This study is comparing the bottom row of cages in a normally CFL lit facility. These are very bright LED’s, more than necessary at about 25 fc in the cage where as the CFL lamps only get 1.4 fc into the cage. On the LED side the only light source is the LED’s atop the cage.
This is what a single lamp on the string looks like, they are actually meant for outdoor signs so good in wet areas. Just need to be dimmer.

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This is how we attached them to the support pipe holding the manure belt of the cages on top.

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As you can see, the birds with CFL lighting (left) have only 1.45 fc average while the LED birds (bottom) have 25 fc.

In spite of being brighter, no behavior or other problems have been noted with the LED lamps.

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DURATION

For Meat Birds

Day 1 - 3 use 20-22 hrs

Day 4 - Processing use 18-20 hrs

All lighting programs used with commercial flocks use the principles of decreasing light stimulation for growing pullets and increasing light stimulation after the pullets have reached a mature production age.

Light is a very strong stimulating factor in poultry and must be carefully managed.

1. NEVER INCREASE the duration or intensity of light during the growing period.

2. NEVER DECREASE the duration or intensity of light during the production period.
0-3 weeks of age - 20 hrs of light daily
3-22 weeks of age – decreasing daylength

Determine the date when the pullets will be 22 weeks of age and find the nearest corresponding date in the table provided. Next to this date is the length of day which should be provided to the pullet at three weeks of age.

This lighting duration should be shortened by 15 minutes each week until at 22 weeks the birds are receiving a natural day length for that time of year. The lights may be turned on before sunrise, turned off after sunset, or both, but the length of light received each day should correspond to the lighting schedule.

At 22 weeks of age the pullets can be placed on a lighting program designed for laying hens.

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Step-down Lighting Program for Pullets
Nearest Date When 22-weeks of Age
Daily Hours of Light

<table>
<thead>
<tr>
<th>Date</th>
<th>Hours of Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 1</td>
<td>15 hr, 15 min</td>
</tr>
<tr>
<td>Feb 1</td>
<td>15 hr, 45 min</td>
</tr>
<tr>
<td>Mar 1</td>
<td>16 hr, 30 min</td>
</tr>
<tr>
<td>Apr 1</td>
<td>17 hr, 30 min</td>
</tr>
<tr>
<td>May 1</td>
<td>18 hr, 15 min</td>
</tr>
<tr>
<td>Jun 1</td>
<td>19 hr</td>
</tr>
<tr>
<td>Jul 1</td>
<td>19 hr</td>
</tr>
<tr>
<td>Aug 1</td>
<td>18 hr, 30 min</td>
</tr>
<tr>
<td>Sep 1</td>
<td>17 hr, 45 min</td>
</tr>
<tr>
<td>Oct 1</td>
<td>17 hr</td>
</tr>
<tr>
<td>Nov 1</td>
<td>16 hr</td>
</tr>
<tr>
<td>Dec 1</td>
<td>15 hr, 15 min</td>
</tr>
</tbody>
</table>

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