Proper exposure = middle value on an average pixel

3 ways to control pixel values so far

<table>
<thead>
<tr>
<th>Shutter speed</th>
<th>Aperture</th>
<th>ISO</th>
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<tbody>
<tr>
<td>slow</td>
<td>big</td>
<td></td>
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<td>30 = 1/30 sec</td>
<td>4</td>
<td>1600 high sensitivity</td>
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<tr>
<td>60</td>
<td>5.6</td>
<td>800</td>
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<td>120</td>
<td>8</td>
<td>400</td>
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<tr>
<td>240</td>
<td>11</td>
<td>200</td>
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<tr>
<td>480</td>
<td>16</td>
<td>100 low sensitivity</td>
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<tr>
<td>fast</td>
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</tbody>
</table>

Other implication of ISO: Noise


$$$$ in camera buys less noise at high ISO

Autoexposure programs (AE)
Wide variety. Stay away if you can.
Semi-automatic programs are better.
Av = aperture priority. You choose the aperture, camera will choose shutter speed. ISO might be automatic too.
Tv = Time priority; you set the shutter speed and ISO, camera AE will choose the aperture.
M = Manual (maybe). You choose both aperture and shutter speed. Meter will tell you if exposure is OK.
How to choose?

Minute paper in groups: list pros and cons of
small aperture vs large aperture

1. short shutter (high shutter speed) vs long (slow)

2. high ISO vs low

3. Deliberate over/under exposure

4) Deliberate overexpose: good for more detail in shadows,
   But lose the highlights
   Deliberate underexpose, good for highlights, bad for shadow detail.

Tv = Time priority; you set the shutter speed and ISO, camera AE will choose the aperture.
M = Manual (maybe). You choose both aperture and shutter speed. Meter will tell you if exposure is OK.

4 ways to control pixel values

1. Deliberate over/under exposure

   Overexposed = More light, or
   more sensitive ISO

   Proper exposure = middle value
   on an average pixel

   Underexposed = Less
   light, less sensitive

   EV = +1

   EV = -1

Shutter speed | Aperture | ISO
---|---|---
30 = 1/30 sec | 4 | 1600 high sensitivity
60 | 5.6 | 800
120 | 8 | 400
240 | 11 | 200
480 | 16 | 100 low sensitivity

Over/under exposure

Lighten image, overexpose compared to AE suggestion +++

Darken, underexpose compared to AE, -----
1. Aperture: large f/ = better DOF, but less light, maybe less sharpness overall
2. Short shutter = freeze the flow, minimize motion blur, but less light
3. High ISO adds noise, but can use low light
4. Need to be careful about which value gets changed to achieve what you asked for.

Usually, set ISO for overall conditions, then choose
Av = aperture priority, let AE (auto exposure) choose shutter
or
Tv = shutter priority, AE chooses aperture

Other considerations of shutter speed: Motion Blur
Short enough to 'freeze' flow, or long enough to get desired particle tracks.
Short:
DSLR Cameras: 1/4000 sec max
High speed video: 20,000 fps, but tradeoff is poor resolution. Tech and prices changing fast here.
Flash: leave shutter open in dark room, then single flash will freeze flow.
"synch" is shortest shutter setting for shutter completely open. Typically 1/30 or 1/60. Slower, down to T or B is good.
Flash on camera or separate
Speedlights: 1/20,000? http://www.scantips.com/speed2.html
In summary, the studio light capacitor is partially charged depending on the power level setting. Then it is always fully dumped when fired, and this is relatively slow. The speedlight capacitor is always fully charged to maximum level, but it is abruptly interrupted to produce lower power settings, and this is often quite fast - however then its comparative power level is rather low.

Pulsed laser Nd:Yag 3-5 ns