Intro to Digital Photography: Exposure Notes

*** Slide 3 So just what is this full stop / f/stop thing? A stop is a unit of measurement that quantifies a ratio of light. A full stop either doubles (2:1) or halves (1:2) the amount of light being delivered. On the camera this is done by changing: shutter speed, aperture, and/or ISO. Some cameras have a button that has a black/white square cut with a diagonal slash that allows to to adjust your exposure value (EV) + or – up to 3 (or in some cases 5) stops in ⅓ or ½ increments.

*** Slide 4 F/stop can also be defined by the focal length of the lens divided by the effective aperture diameter.

*** Slide 5 And because focal length changes between lenses, as well as the effective aperture diameter, f/stop is a dimensionless number. F/4 on a 100mm focal length lens means that the diameter is 25mm, while f/4 on a 200mm focal length lens means that the diameter is 50mm. With the exception of macro lenses, f/4 at 100mm or 200mm focal length will deliver the same amount of light onto the sensor; this holds true for f/8 or f/16 on both lenses, or f/4 at 28mm, f/4 at 35mm, f/4 at 50mm, and f/4 at 100mm: the same amount of light will be delivered onto the sensor across all focal lengths.

*** Slide 6 Here is a simple prime lens (i.e., fixed focal length) of 50mm. The focal length is the distance from the front lens element to the sensor. Light is coming from an infinite distance, getting bent and inverted by the lens to hit the sensor. The point where the light rays cross and the image flips over is known as the nodal point; very high end tripods for panoramic photography rotate the camera around the nodal point to eliminate distortion caused by trying to image an arc onto a flat plane.

*** Slide 7 Another way of thinking about aperture is as a fraction. For example, at f4 on a 50mm lens, my effective diameter is 12.5mm (50mm/4). The distance from the front of the lens to the sensor takes four effective diameters. F4 is ¼ of my maximum possible aperture opening of f/1 (f/1 in this case would be an effective diameter of 50mm).

*** Slide 8 At f/8, my effective diameter is 6.25mm (50mm/8), and it take eight effective diameters to span the distance of the focal length.

*** Slide 9 If I were to take the area of the diameter of the f/4 and the area of the diameter of the f/8, it would take 4 f/8 diameters to equal the diameter of the f/4, making f/8 two stops away from f/4. F/8 only delivers ¼ the amount of light of f/4. This ratio hold true across the f/stop range: a single f/stop changes the ratio of light by a factor of 2, two f/stop range changes the ratio of light by a factor of 4, and three f/stop range by a factor of 8. F/2.8 to f/4 is a factor of two, f2/.8 to f/5.6 is a factor of 4, and f2.8/ to f/8 is a factor of 8.

*** Slide 10 The camera is, above all else, a light meter. It measures the quantity of light and from that calculates (on AUTO or PROGRAM modes) the shutter speed, aperture, and ISO needed for an on exposure picture. You might recall that there are two types of light that concerns photography: incident and reflectance. Incident light is all light falling onto a given subject, reflectance is the incident light that the subject is reflecting. So it should come as no surprise that there are two types of light meters: incidence and reflectance. Your camera is a reflectance meter for it is measuring the amount of light being reflected from the subject; it doesn't measure the quality of light--the camera doesn't care if the light is from a point source and very hard or from a diffuse source and very soft--all it cares about is the amount of light.

You can also buy hand-held light meters. These are very useful in a studio setting to get the lights adjusted to a specific f/stop value, for example f8. Hand-held meters can be incidence or reflectance. In incidence metering, you put the meter next to the subject and measure the light hitting it in f/stops; you then set your aperture to this value--some meters will also give you the shutter speed. Reflectance meters work just like the camera in that it measures the light coming from your subject and then calculates your exposure.

There are other tools that you can use to get your f/stop. Expodisc is a tool that goes on front of the camera lens and can turn your camera into an incidence meter. With the Expodisc on the lens, you take a photo next to the subject of the strongest light source. Besides giving you a neutral gray image to do color balancing off of, the image on the camera will also give you the f/stop value for the given shutter speed and ISO. The Expodisc is also handy to have if you're in an environment of changing lighting conditions and need calibration images for white balance.

*** Slide 11 The camera does it's metering through the lens (TTL), so the light coming though the lens is what the camera is using for it's evaluation. Most digital cameras have four selectable metering systems: evaluative (matrix for Nikon shooters), center-weighted, partial, and spot. Evaluative / Matrix metering takes in the entire scene and gives an equal weight to every light source; if you have a really bright source and some deep shadows, the exposure will balance between the two, leaving some of the bright light overexposed and some of the shadows underexposed.

Center-weighted metering predominantly evaluates the center of the image for exposure, but will also take into consideration some of the surrounding area. Different cameras do center-weighted differently, some giving more consideration to the lower half of the image than the top, for example. The corners are typically ignored for metering purposes.

Partial metering looks at the center of the image; this area is roughly the center 13% - 18% (depending on camera).

Everything else is ignored for metering purposes.

Spot metering is the center 3%, everything else is ignored.

So, what do you meter?

Evaluative metering is useful for images that have no extremes--no bright lights, no deep shadows. People tend to use evaluative for landscapes, but the problem here is that usually the sky is so much brighter than the land, that to bring the sky in the land will be underexposed; instead do partial metering on the land to get it correctly exposed knowing that the sky will be overexposed, but this is generally OK for most of the time there is little of interest in the sky.

For people, spot meter on the face, for you want to get this properly exposed.

*** Slide 12 Exposure has an affect on color. Underexposing tends to make colors slight darker and richer in tone; many people actually prefer images that are slightly (⅓ to ½ stop) underexposed for the color saturation. Overexposing tends to fade out colors.

As a rule of thumb it is better to slightly overexpose (⅓ to ½ stop) images. Digital noise hides in shadows and underexposing images increases the chance, especially at higher ISOs, of increased digital noise. While overexposing might wash out colors a little bit and fade out shadows, image editing software has an easier time making overexposed images darker than underexposed images lighter. This is also known as "exposing to the right" for most cameras the exposure meter as viewed through the viewfinder has overexpose to the right of the center line; and histograms have the lighter pixels to the right of center.

*** Slide 13 Here is an example of metering problem. You have an overcast sky that is very bright, so what do you meter?

Use evaluative metering; while some of the sky and the land will not be exposed, in general this is the best option. Alternatives would have been to use a graduated neutral density filter to knock down the sky by a stop or two, or take multiple images at different exposures (exposure bracketing) and then combine them via software.

*** Slide 14 Here is a photo from Scotland. I used spot metering and metered on the sky. As you can see, the sky is properly exposed--you can see detail in the clouds. But everything else is hopelessly underexposed.

*** Slide 15 Here the hillside is, more or less, properly exposed (so said the camera--I would have preferred it to be just a little darker). The sky is completely washed out, no detail. An evaluative / matrix metering would have seen the bright sky, the bright water, and the dark hill and

compensated; the sky and water would not have been so bright and the hill would not have been so dark.

*** Slide 16 Using image editing software I was able to put the correctly exposed sky onto the more or less correctly exposed hill. Ideally I should have taken three pictures, one with the water also correctly exposed. This is closer to what I was seeing when I took the photograph. If I was going to do further work on this image, I'd move the exposure down probably by at least ½ of a stop to make things just a little darker.

*** Slide 17 Many cameras have the ability to to automatic exposure bracketing (AEB), and many photographer swear by this. AEB takes a series of photographs at different exposure values defined by you, anywhere from ⅓ to a full stop apart. AEB will either vary the shutter speed or the aperture to get the alternate exposures, you can define which one to vary. To make high dynamic range (HDR) images you need to do exposure bracketing and make at least three images: one underexposed, one on exposure, and one over exposed. Be aware that if you use AEB and vary the aperture you will be affecting the depth of field (DoF) which may be an issue (it is for HDR images); to be on the safe side, tell your camera to do AEB by varying the shutter speed.

*** Slide 18 Here is a 7 exposure shot of stained glass in Glasgow Cathedral. I did spot metering on the stained glass which is the brightest thing in the image. Next I set my camera (Nikon) to take a series of seven exposures that were 1 stop apart and to do so by varying my shutter speed; because of the nature of the image, I was on a tripod and using a cable release as my shutter. The center image is the one that the camera said was on exposure, while in real life what I was seeing was the stained glass from the −1 stop and the detail from the +3 stop. If I was to use AEB only, I would have gone with the +1, +2 and +3 stop over exposed images. Since I shoot in RAW, I have the ability to go in and edit this image with more capability than if I had shot it in JPG only. In JPG only I would have gone with probably +1, +1.5, and +2 overexposure for my set and probably would have called +1.5 good.