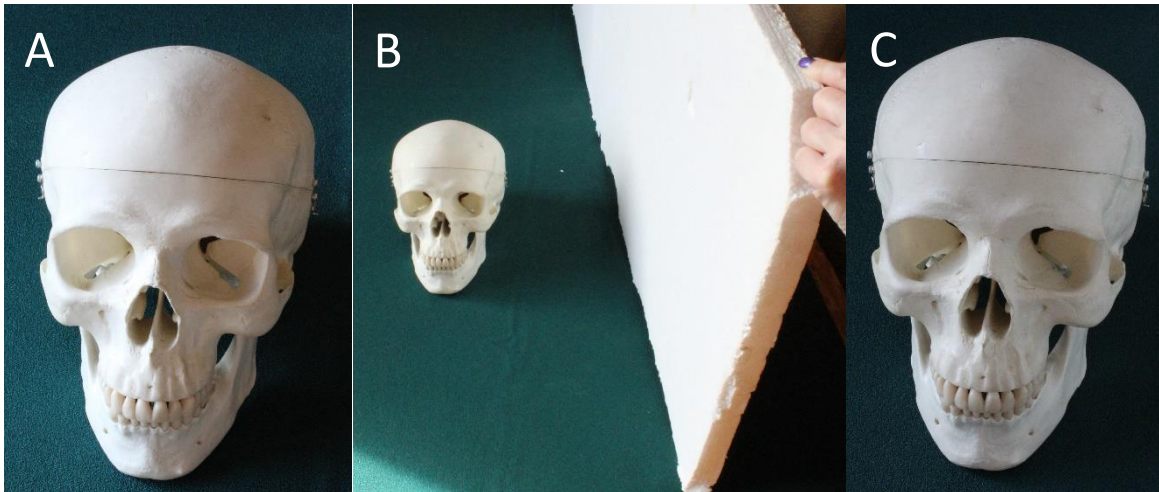**Appendix 1: Guide to take photos for photogrammetry reconstruction**

This short guide will tell the important factors of taking images for photogrammetry. The last page is an abridged quick guide, what can be printed and used as reference sheet.

Lighting: Lighting has the most fundamental effect on photogrammetry reconstruction. Deep shadows, moving shadows or high contrast areas often make impossible to create a high quality 3D model.
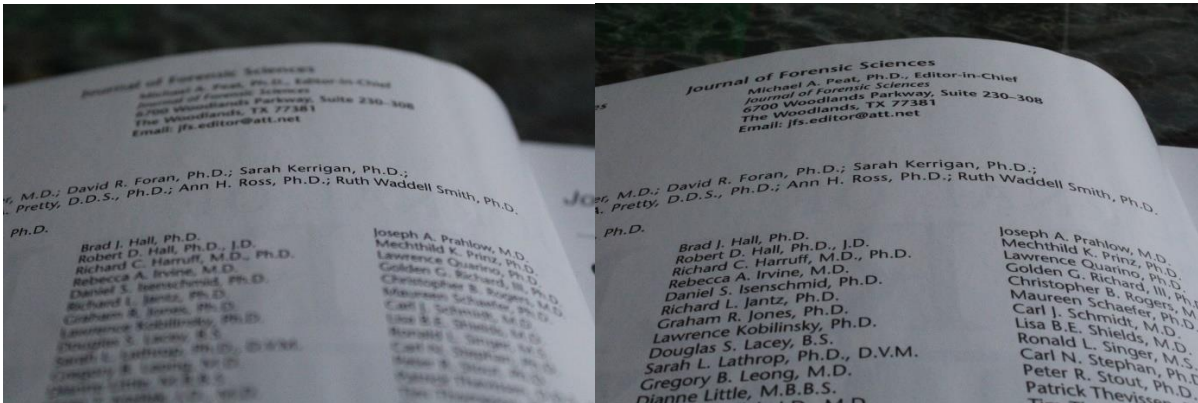
- *Turn on all the light sources in the room. Let natural light in, but avoid direct sunlight, as it will create deep shadows.*
- *Turn off the flash of the camera or phone.*
- *If there are light sources only on one side of the object, shadows can be mitigated by "bouncing" light back to the object. An example can be seen in the following images:*

The light source was a window on the left side. (A) The right side of the skull is significantly darker. (B)Bouncing back some light lightens the dark areas. (C) The lighting is homogenous.

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Depth of field: Depth of field (DOF) is the distance range where the object is sharp or in focus. The following image pair show this effect.

Left: shallow DOF means that only the middle of the object is sharp enough. Right: deep DOF renders both the foreground and the background sharp.

Depth of field set up:

On advanced cameras set A or Av mode (Aperture priority), then set the f value between 16 to 22.

On compact cameras set landscape mode.

Smartphones usually take pictures with deep depth of field. Make sure that portrait mode or background blurring is turned off.

Sensitivity: High sensitivity setting will decrease the chance for blurry pictures caused by handshake and camera movement.

Set ISO to automatic mode or set it manually 1600 to 3200.

Usually smartphones will set ISO high enough.

Overlapping images: Photogrammetry software can stitch together images and reconstruct 3D models by recognizing common points of photos. Thus it is crucial to have at least 60% overlap between images. An example can be seen below.

Quick guide

Set soft, even lightning. Reduce shadows with white panels if necessary.

Settings for photo cameras

- turn on autofocus
- set it to A (Av) mode and set f: 16 to 22 OR set landscape mode
- set ISO auto or 1600 to 3200
- turn off flash

Settings for smartphones

- use the 'normal' camera, not the wide angle one
- turn off 'portrait' mode or background blurring
- turn on HDR (or leave it auto mode)
- use the volume button to take pictures instead of the onscreen button
- turn of flash

Taking photos:

Hold the camera steady and low, parallel to the table. Press the shutter button halfway and wait until the autofocus locks. Press the shutter button all the way down and take the picture. Take one small step to the side (ca. 30-40 cm). Keep taking pictures until you make a full round around the table.

Hold the camera higher, aiming at the object at around 45°. Repeat the above described steps.

Hold the camera above the object pointing straight down and take pictures from one side to the other.

If there are areas of special interest of the body, take additional close up pictures of that region.