Imaging the eye with the smart phone

"the art of phoneoscopy"

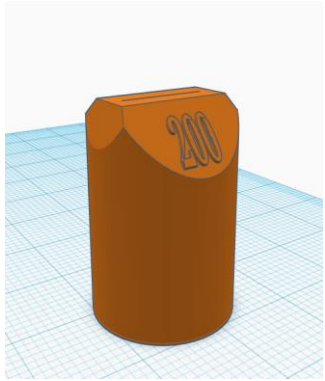
Before we start

Check phone

- Charge phone
- Remove phone case
- Add Tim to WhatsApp +447782219868
- Download app
  - iOS
    - ProCamera (preferred)
    - Camera + / +2
  - Android
    - Open camera (preferred)

www.TheEyePhone.com for tips

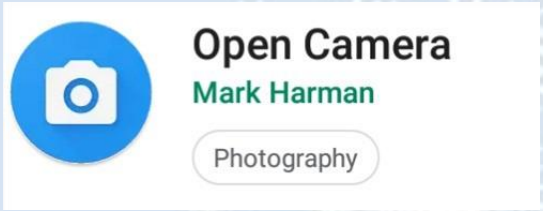
Check equipment



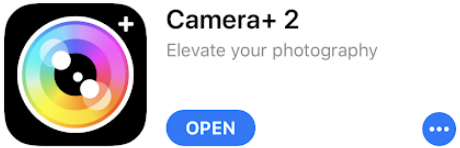
- Pen torch
- Slit beam adaptor
- 20D lens
- Macro lens:
- Eye model:3 types, 3 configurations
  - **Cornea** (slide holder and cornea simulacrum, slide)
  - **Anterior segment** (2 lenses and iris)
    - Ant chamber (clear lens)
    - Iris (printed simulcram)
    - Lens (ant and post opacities)
  - **Posterior segment** (1 lens)

Android

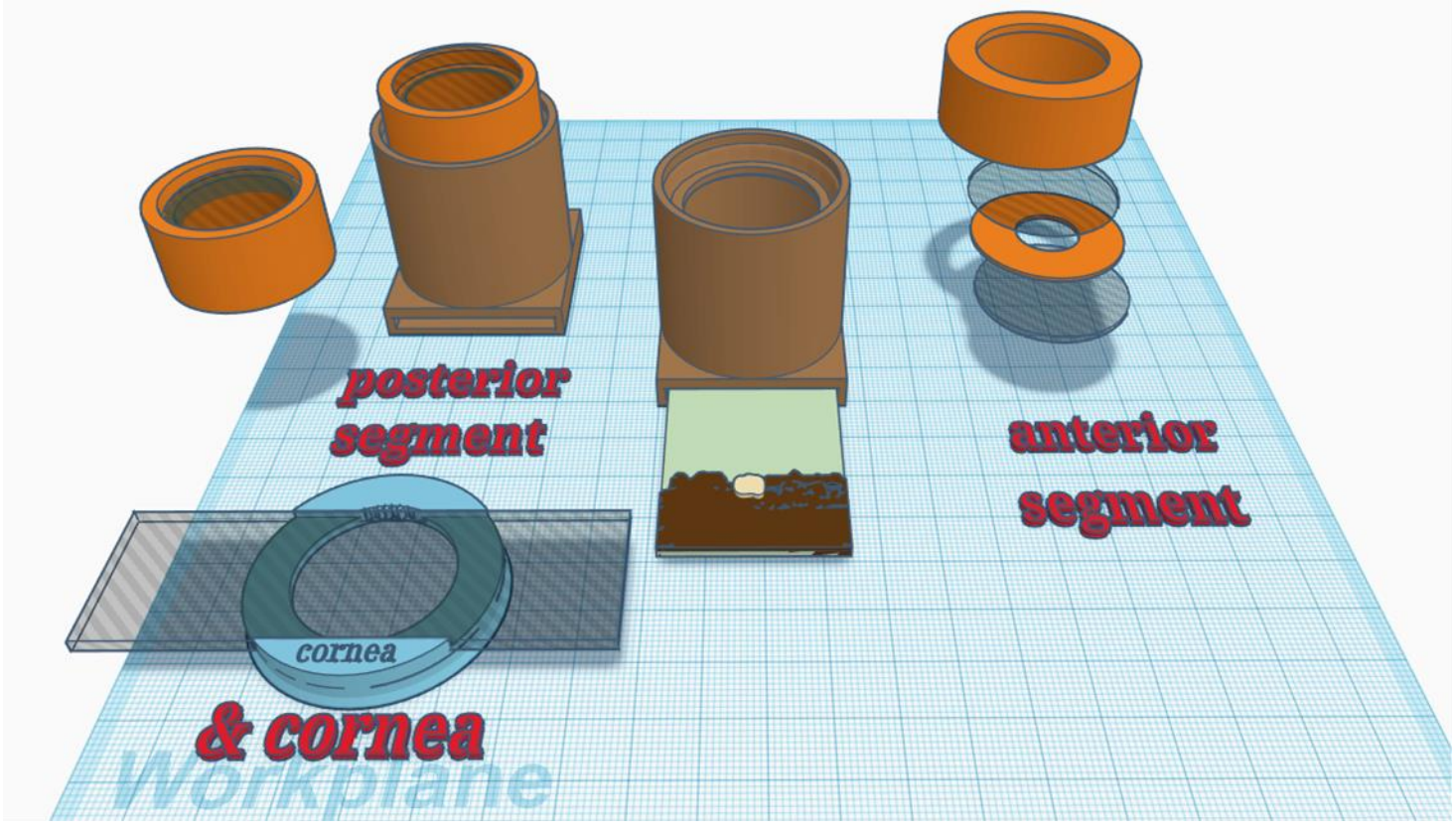
www.opencamera.org.uk



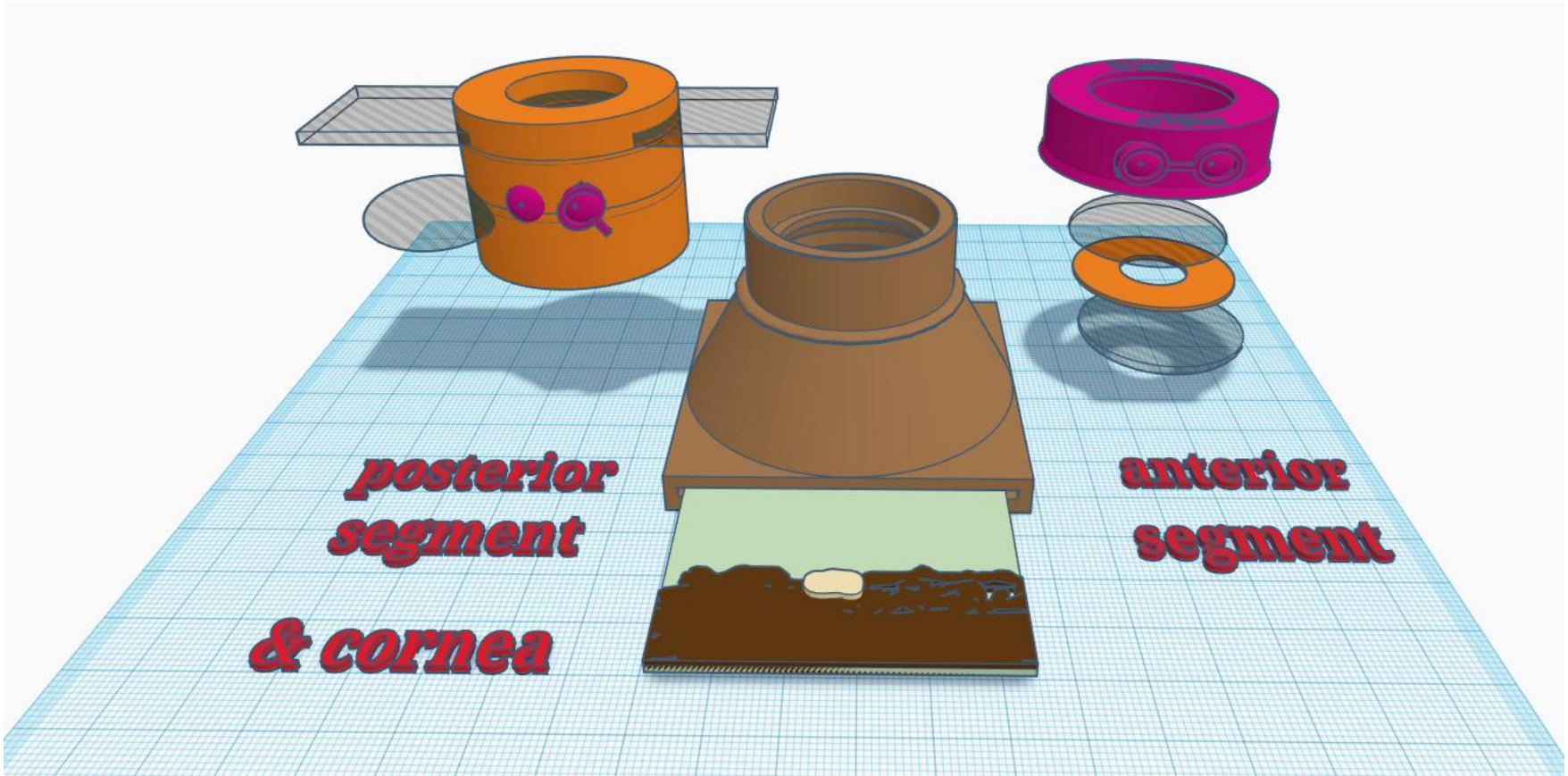
iPhones



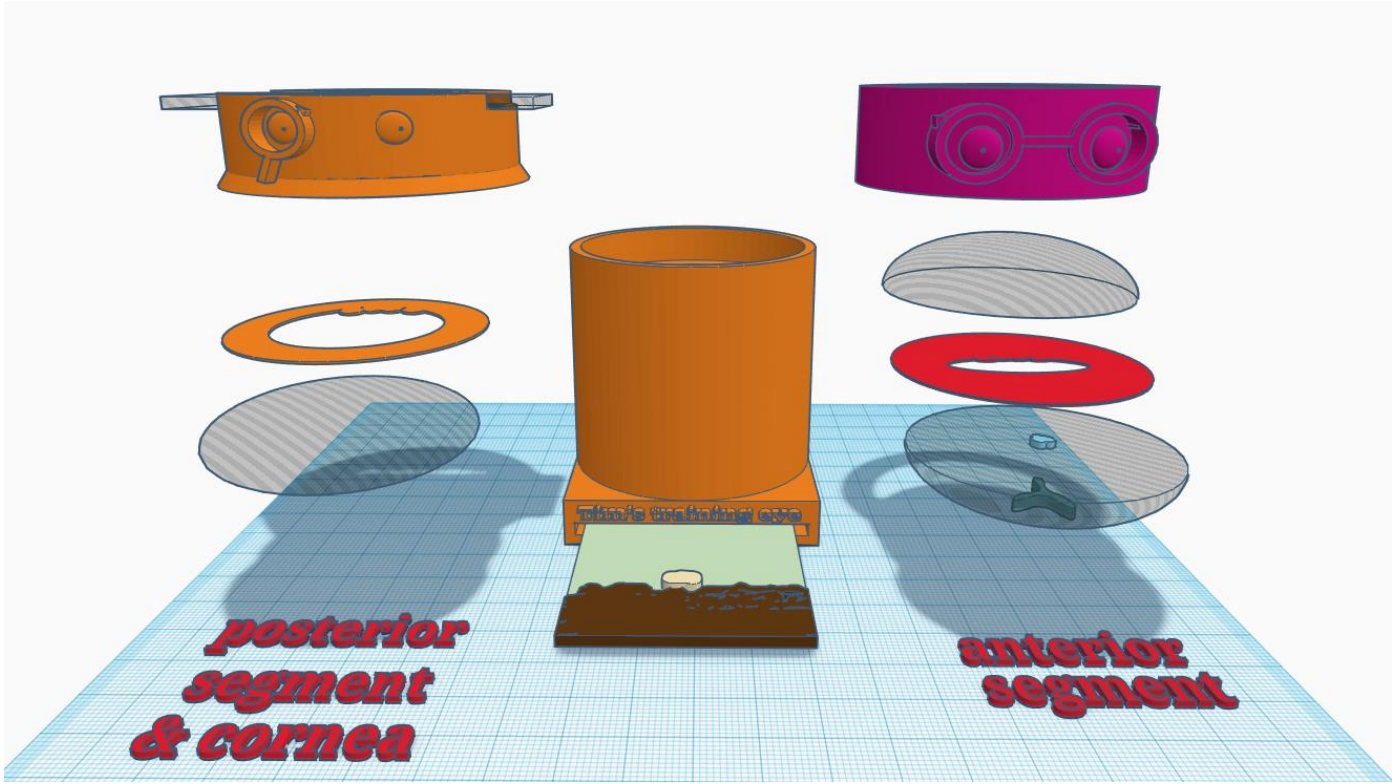
Small animal training eye (small fundus)

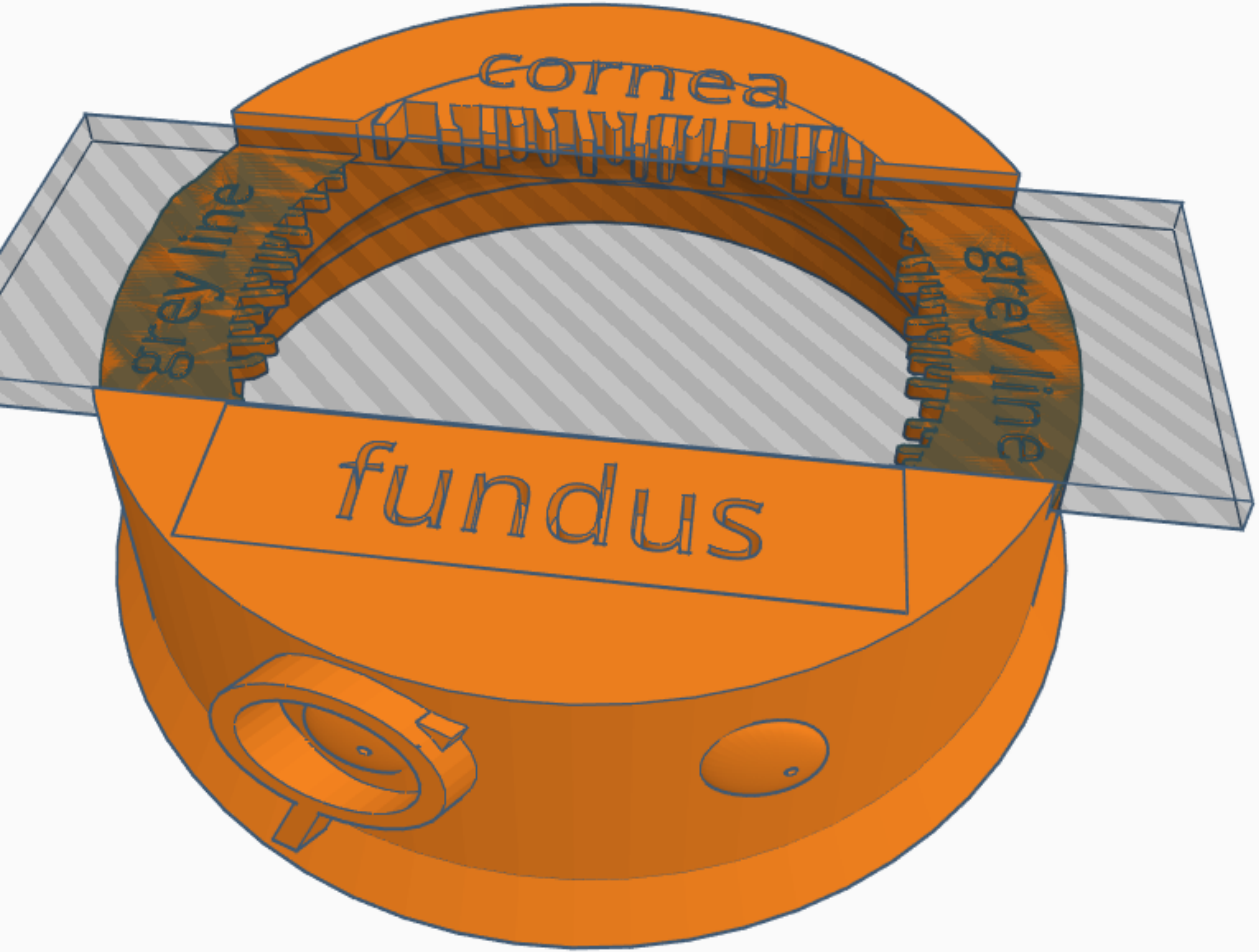


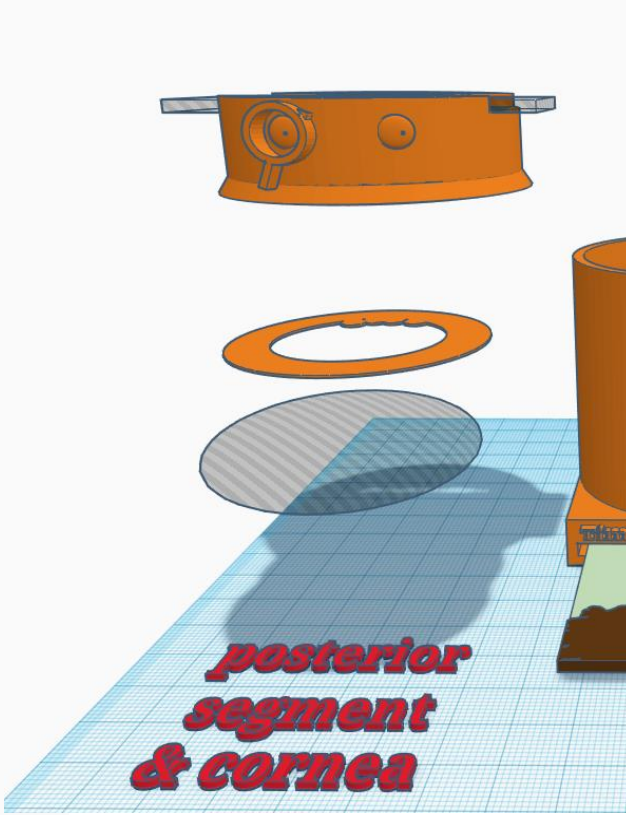
Small animal training eye (large fundus)



Large animal training eye




cornea
grey line
grey line
fundus


posterior
segment
& cornea

What’s the best camera for taking eye pictures?

*“The one you have with you **and** you know how to use.”*

- DSLR: Canon 760d
  - 50mm Yongnuo prime lens f1.8 and extension tubes
  - Pop up flash
- **iPhone (and iPod touch)**
- Compact canon ixus

Tips:

- SD card in wallet
- USB charger in car
- SD phone adaptor

Using photography as a clinical tool

“Standard photo documentation”

- Video recordings of visual assessment (obstacle course, menace, tracking etc)
- Whole patient (and identity document)
- Head, front aim to get both tapetal reflections
- Face, laterals
- Whole eye. Three views, caudal, cranial(aim to skyline corneal curvature and anterior chamber) and lateral.
- Eyelids; everted superior and inferior margins, TE (prolapsed) and medial canthus/caruncle
- Distant direct view; lateral, caudal, cranial and inferior pre dilation to record visual axis
- “sneak peak” at retinas pre dilation to ID gross retinal and vitreal pathology

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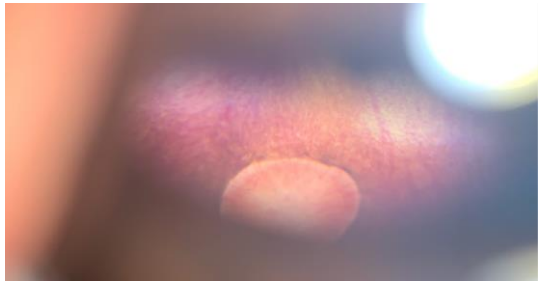

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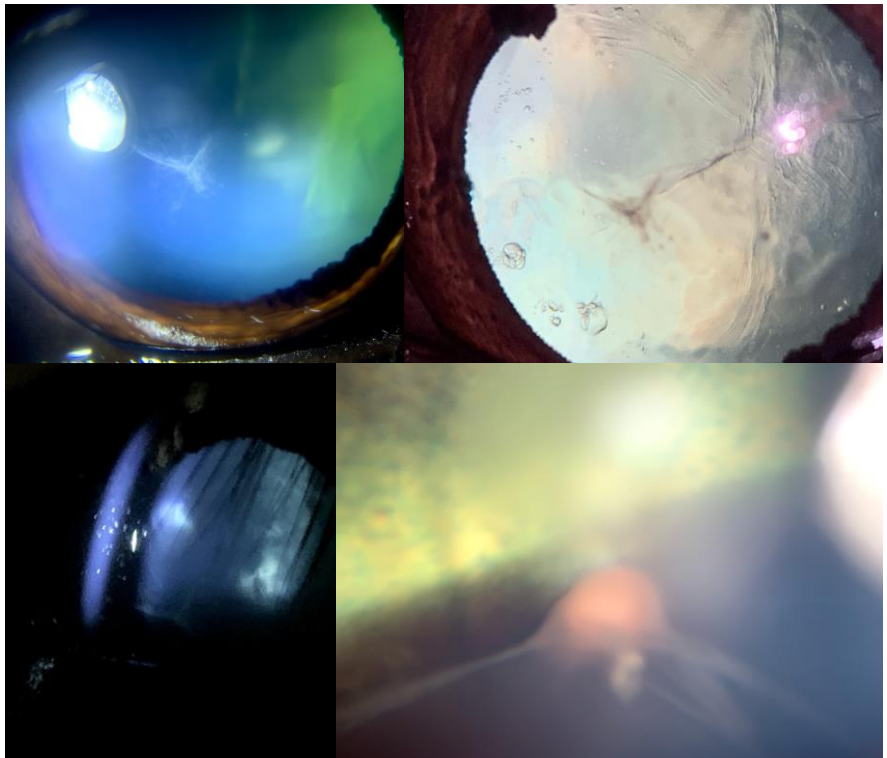
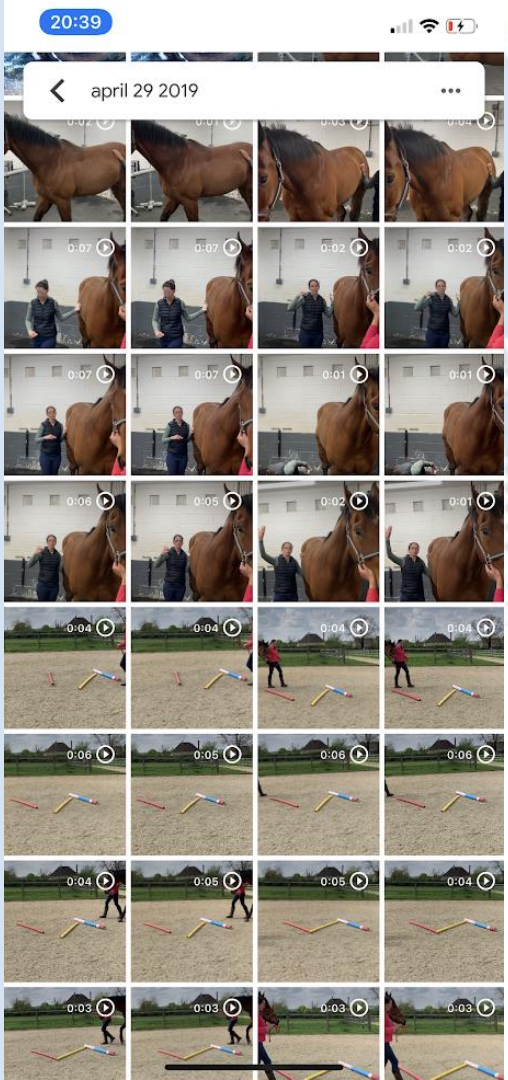
- Then document pathology..

Recording pathology

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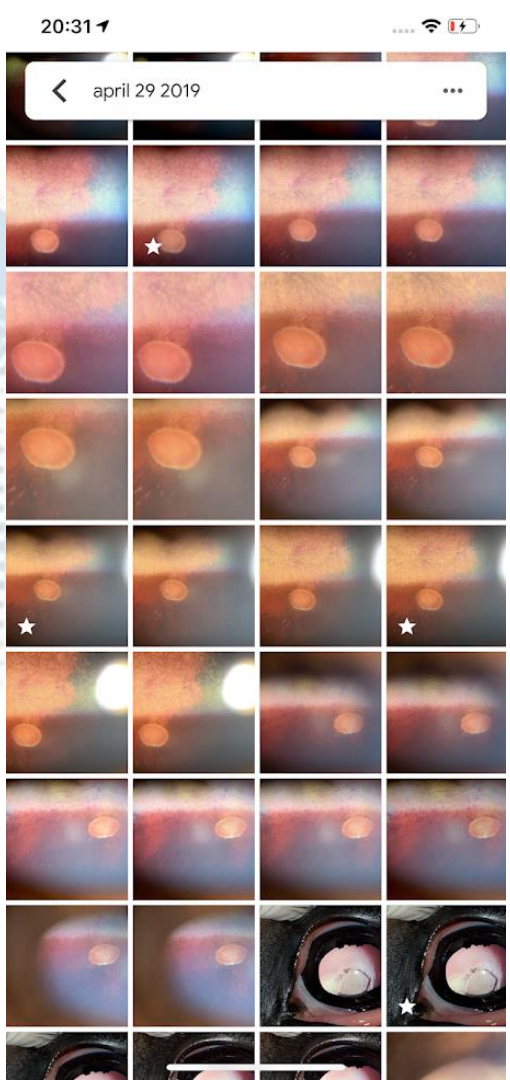
april 29 2019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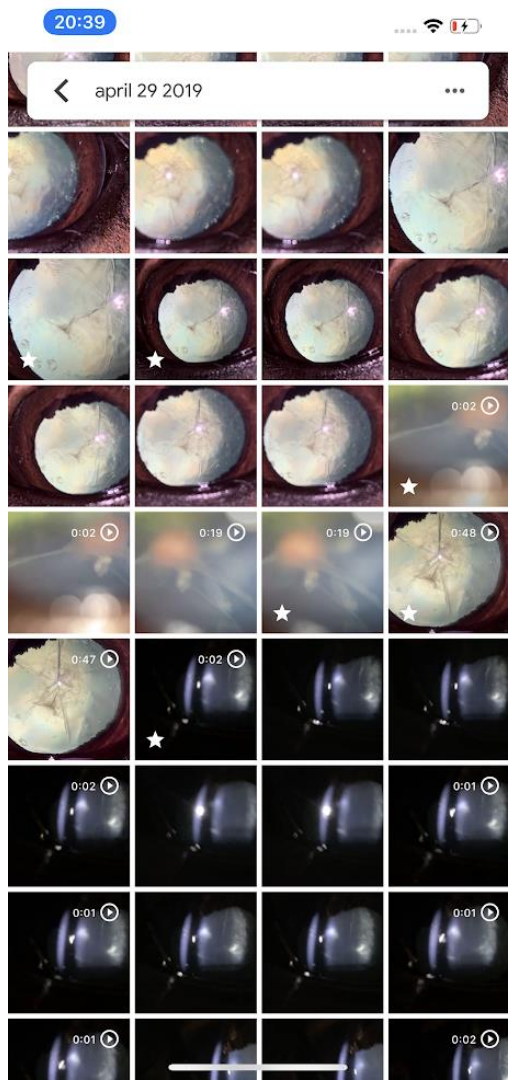
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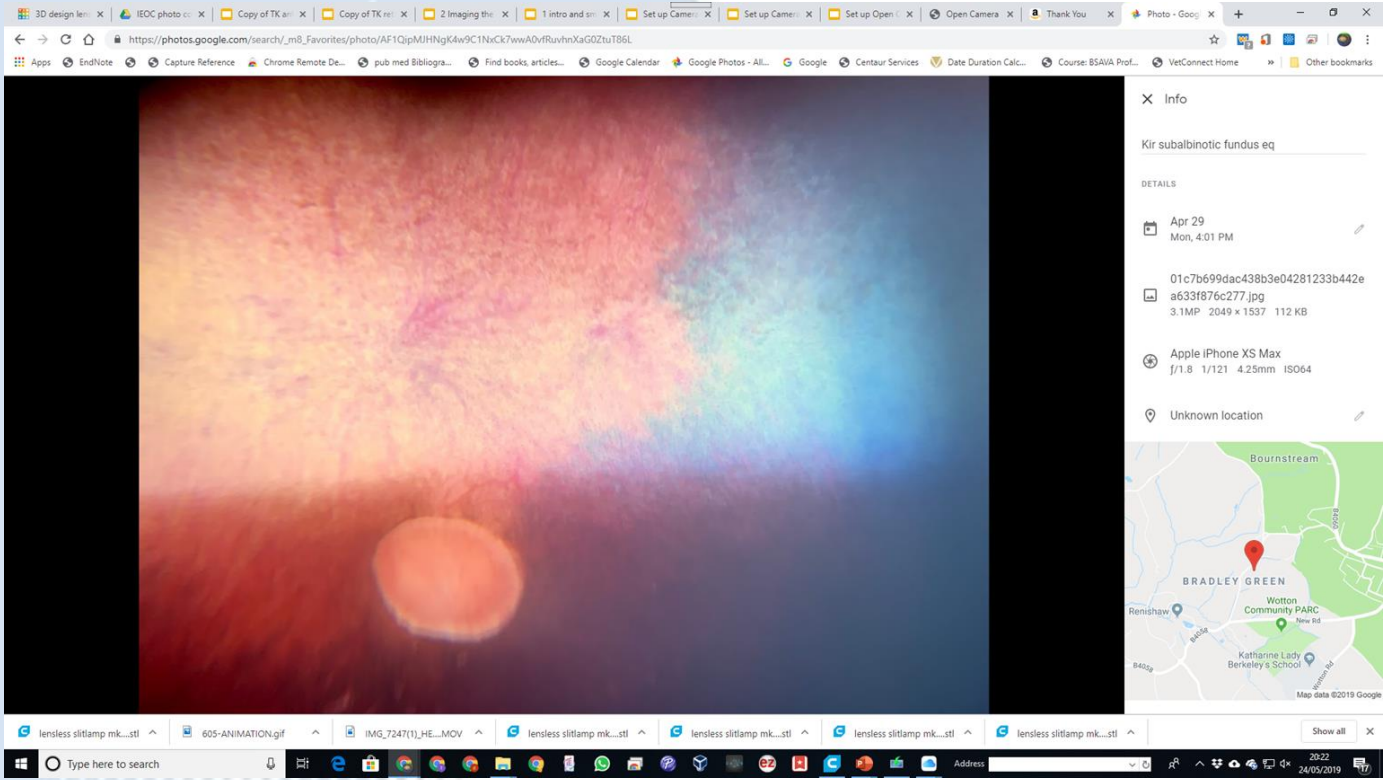
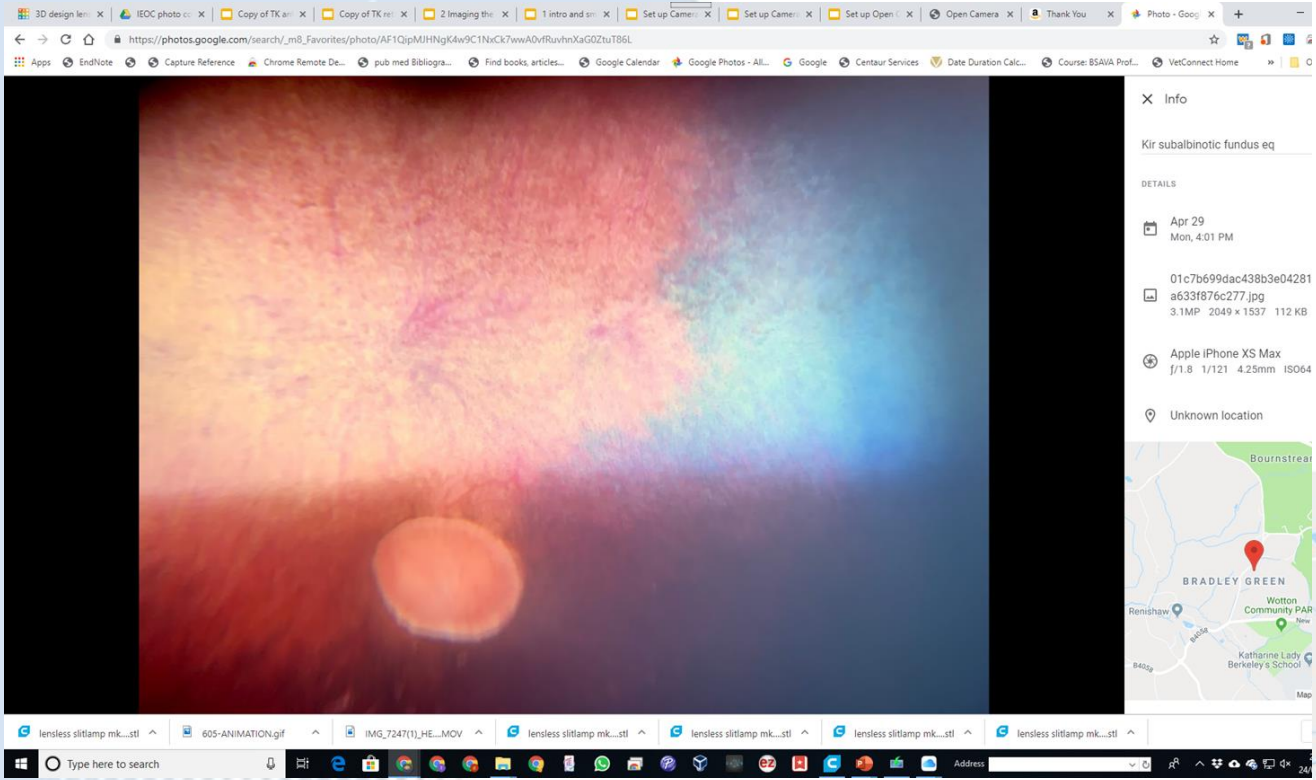
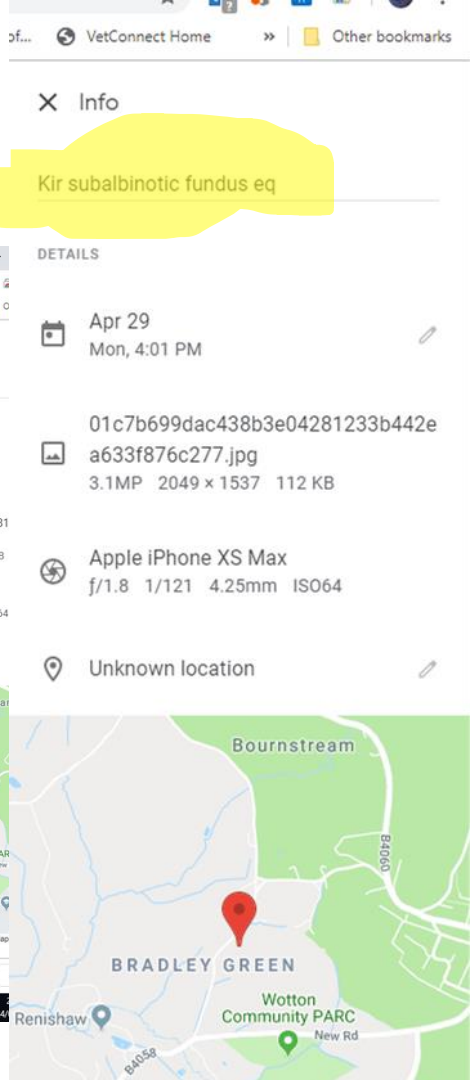
april 29 2019

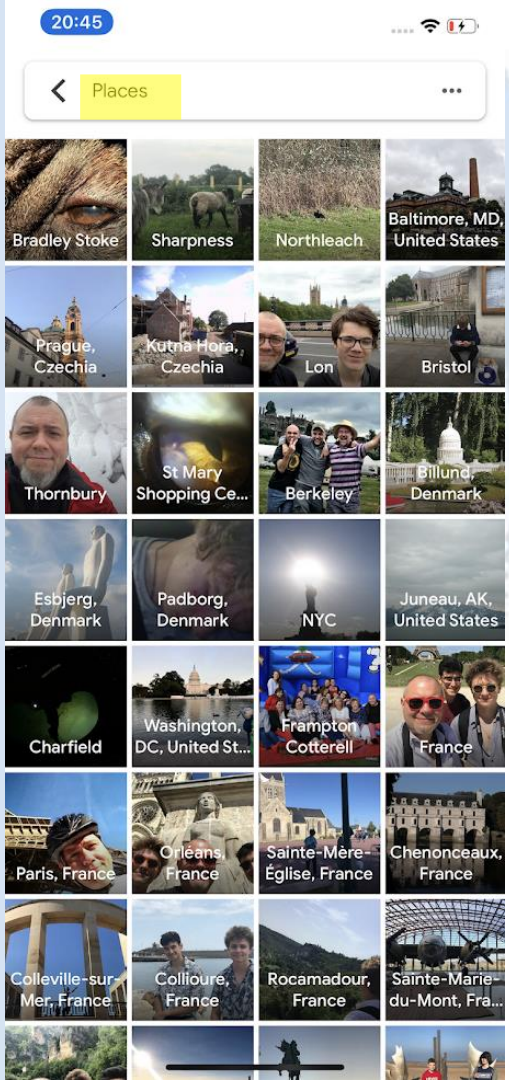
Managing your photos

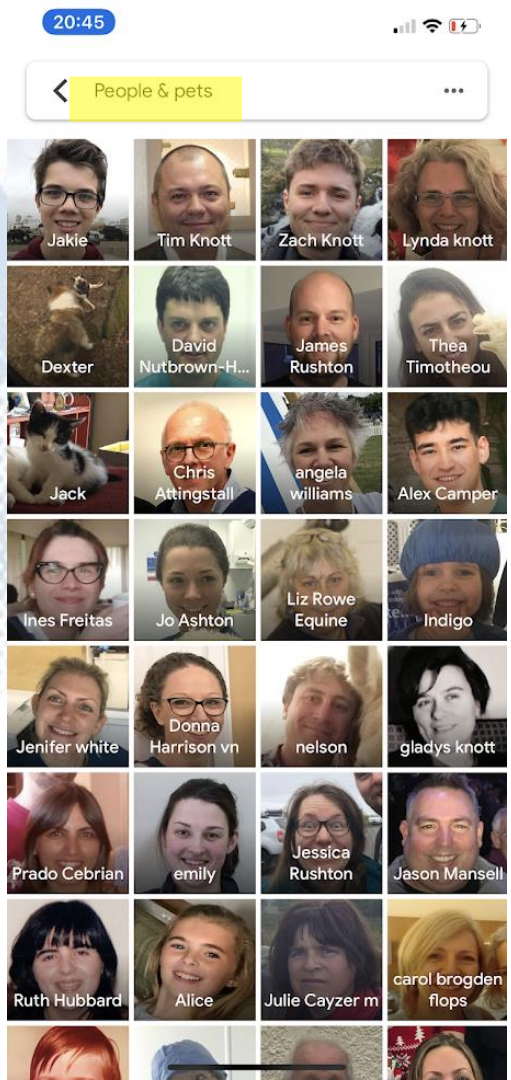


Managing your photos






20:45
Places
Bradley Stoke
Sharpness
Northleach
Baltimore, MD, United States
Prague, Czechia
Kutna Hora, Czechia
Lon
Bristol
Thornbury
St Mary Shopping Ce...
Berkeley
Billund, Denmark
Esbjerg, Denmark
Padborg, Denmark
NYC
Juneau, AK, United States
Charfield
Washington, DC, United St...
Frampton Cotterell
France
Paris, France
Orleans, France
Sainte-Mère-Église, France
Chenonceaux, France
Colleville-sur-Mer, France
Collioure, France
Rocamadour, France
Sainte-Marie-du-Mont, Fra...


20:45
People & pets
Jakie
Tim Knott
Zach Knott
Lynda knott
Dexter
David Nutbrown-H...
James Rushton
Thea Timotheou
Jack
Chris Attingstall
angela williams
Alex Camper
Ines Freitas
Jo Ashton
Liz Rowe Equine
Indigo
Jenifer white
Donna Harrison vn
nelson
gladys knott
Prado Cebrian
emily
Jessica Rushton
Jason Mansell
Ruth Hubbard
Alice
Julie Cayzer m
carol brogden flops

20:57
grey
0:01
0:01
0:01

20:43

grey horse 2018

Tue, 11 Dec 2018

Mon, 10 Dec 2018

20:46

nelson grey horse

IN ALBUMS

Sunday in Wotto...

Sun, 7 Jan 2018

Tue, 22 Apr 2008

20:58

melanoma

Sun 28 Apr

Mon, 30 Jul 2018

Sun, 24 Jun 2018

Mon, 9 Oct 2017

Thu, 16 Mar 2017

Mon, 15 Aug 2016

photography basics:

Focus Exposure Depth of field

“Focus first “

Almost everything else can be fixed in post processing - prioritize focus!

“if you're too close you can't focus - Know your minimum focal distance “

Avoid camera shake by ensuring shutter speed fast enough

“Focus first “

Almost everything else can be fixed in post processing - prioritize focus!

“if you're too close you can't focus - Know your minimum focal distance “

Avoid camera shake by ensuring shutter speed fast enough

Exposure

“Camera’s see more than we can”

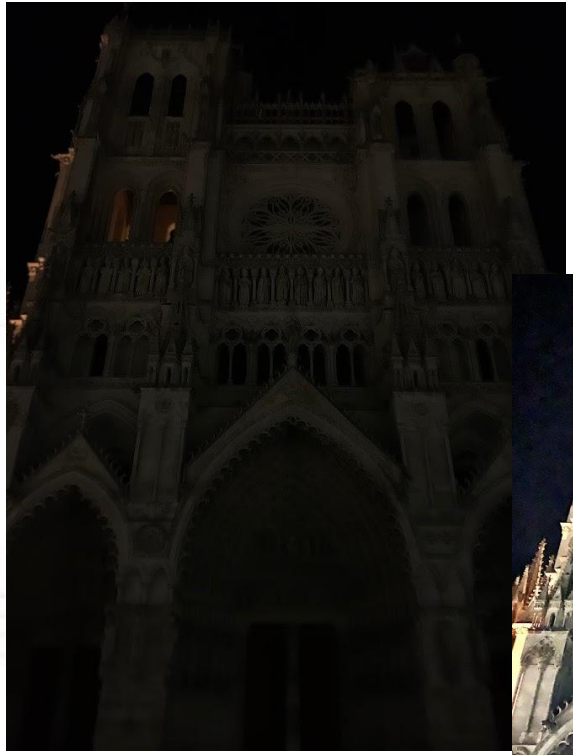
Dark images often carry lots of information- especially RAW images

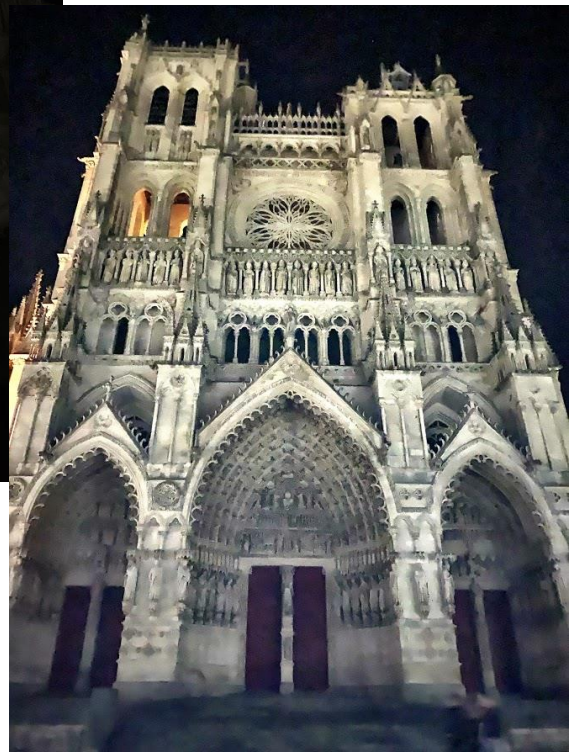
...whilst over exposed images contain very little.

1st add light

2nd increase shutter speed (but never at the expense of focus)

3rd increase sensitivity (ISO)





Exposure

*“Dark images often carry lots of information- especially **RAW** images”*

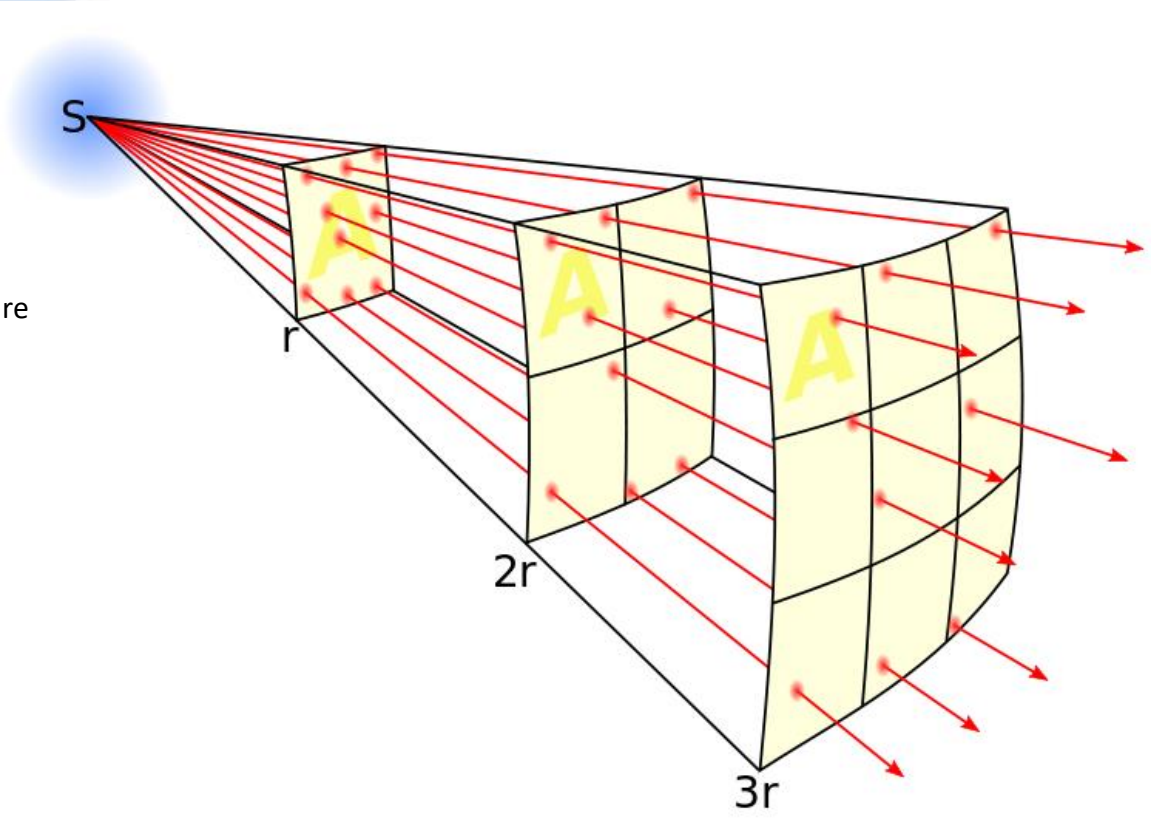
“Whilst over exposed images contain very little”

Exposure: add light

“Light intensity increase and decreases **rapidly** with changes of distance”

Light intensity is proportional to the square of its distance - the inverse square law.

But remember not to add too much...



“Phones are great but DSLRs **are** better”

“Light is the medium which carries the information we want”

The lens collects light

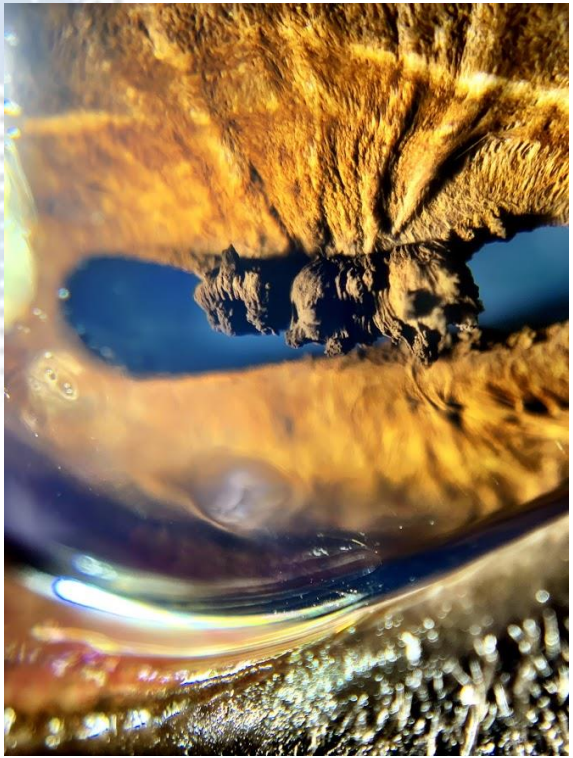
The CCD records light

Small lenses & CCDS can only do so much - the phone’s computer can help

DSLR CCD = 865 mm2

Phone CCD= 25 mm2

“aim for the best image without cropping”



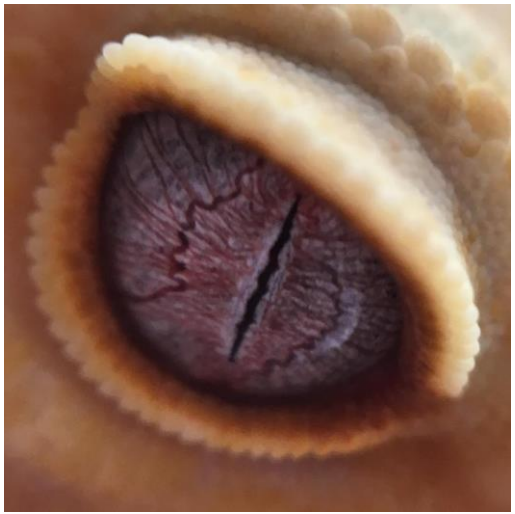
Depth of field

“Decreases as magnification increase”

“Increase by reducing aperture …… but you can’t with camera phones”

Increase by reducing magnification

Use stacked images to illustrate (google photo animations)



Matthew Dobson, iPhoneSE, x10 macro lens

Depth of field

“Decreases as magnification increase”

“Increase by reducing aperture …… but you can’t with camera phones”

Increase by reducing magnification

Use stacked images to illustrate (google photo animations)

Depth of field

“Decreases as magnification increase”

“Increase by reducing aperture …… but you can’t with camera phones”

Increase by reducing magnification

Learn to use your phone like your slit lamp

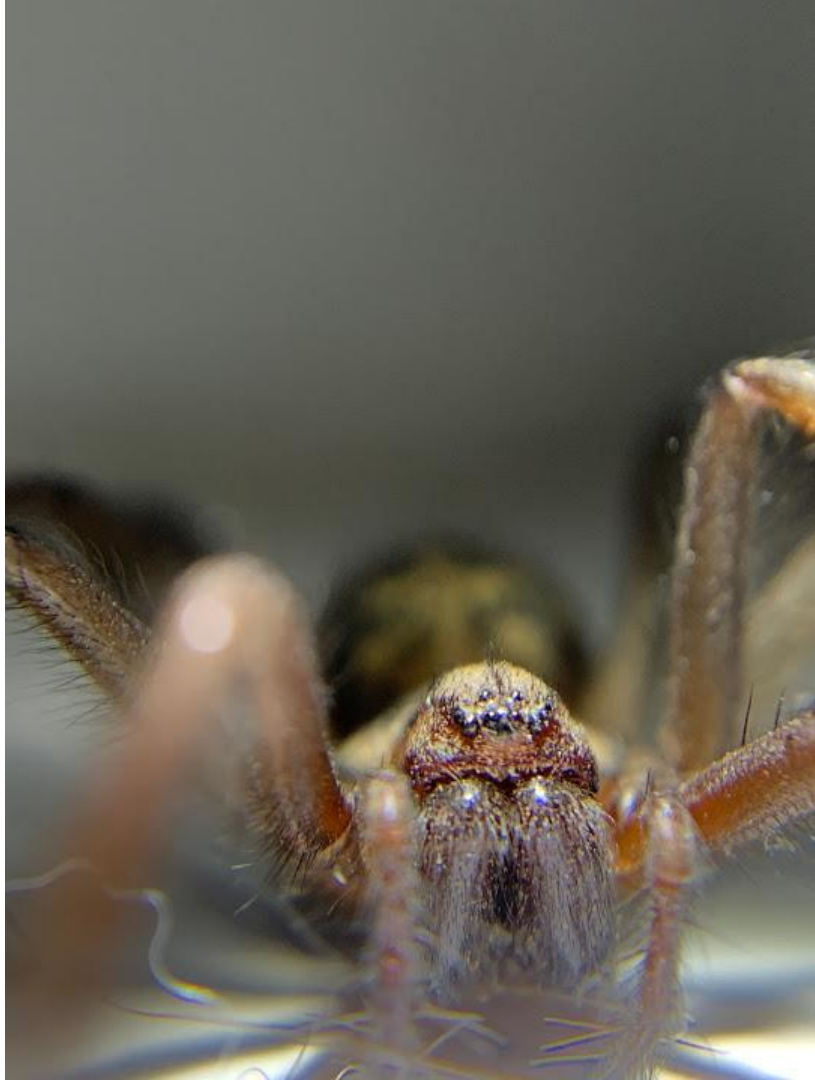
Use “stacked images” using:

- google photo animations
- Live view
- Video

Depth of field

iPhoneXSMax, 10x macro lens, telephoto lens, oblique lighting

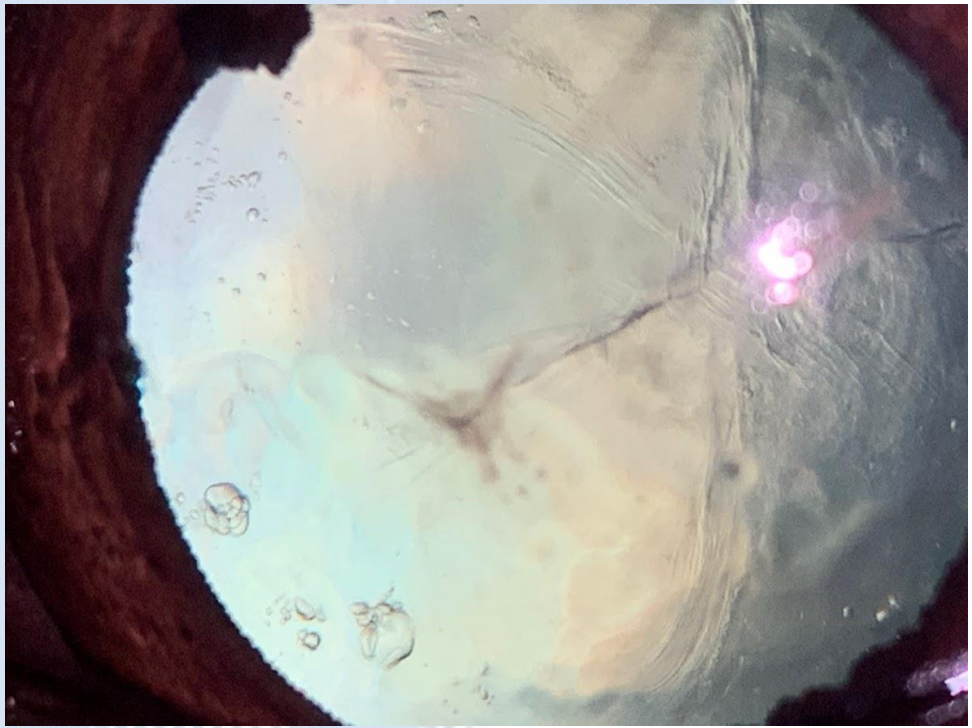
Giant House spider, Eratigena atrica



Why use your smartphone to image the eye?

“Using your phone as a digital ophthalmoscope”

The magic of the fundic reflection



Light to lens distance

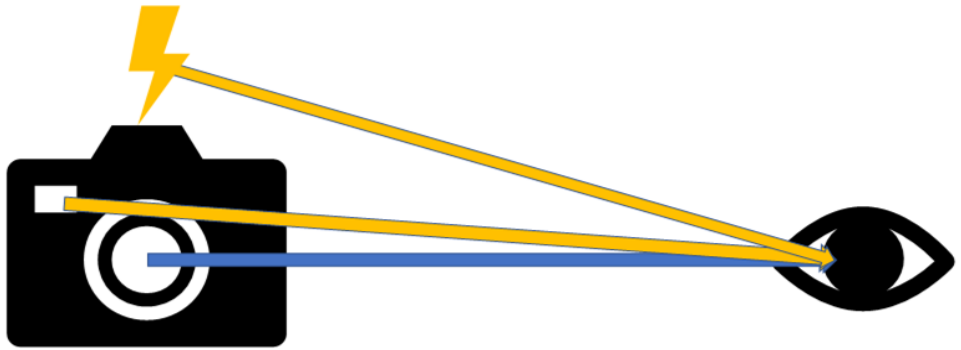
LLD is directly proportional to the angle between the incident light and the camera's optical axis.

Camera to patient distance if inversely proportional to this same angle.

Pupil diameter is directly proportional to the angle of incident light required to obtain a fundic reflection

"Getting the fundic reflection"

move away +/or enlarge pupil +/or reduce LLD



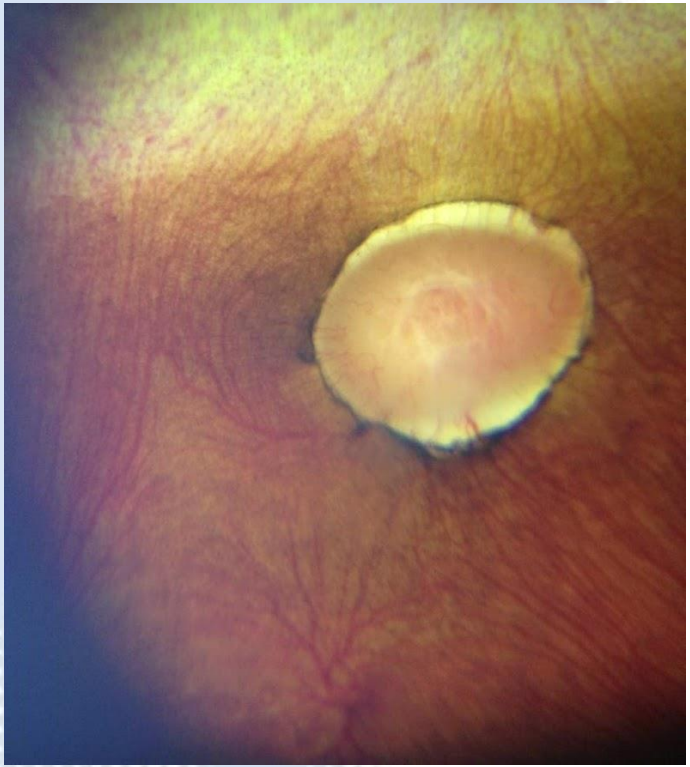
Light to lens distance

85mm

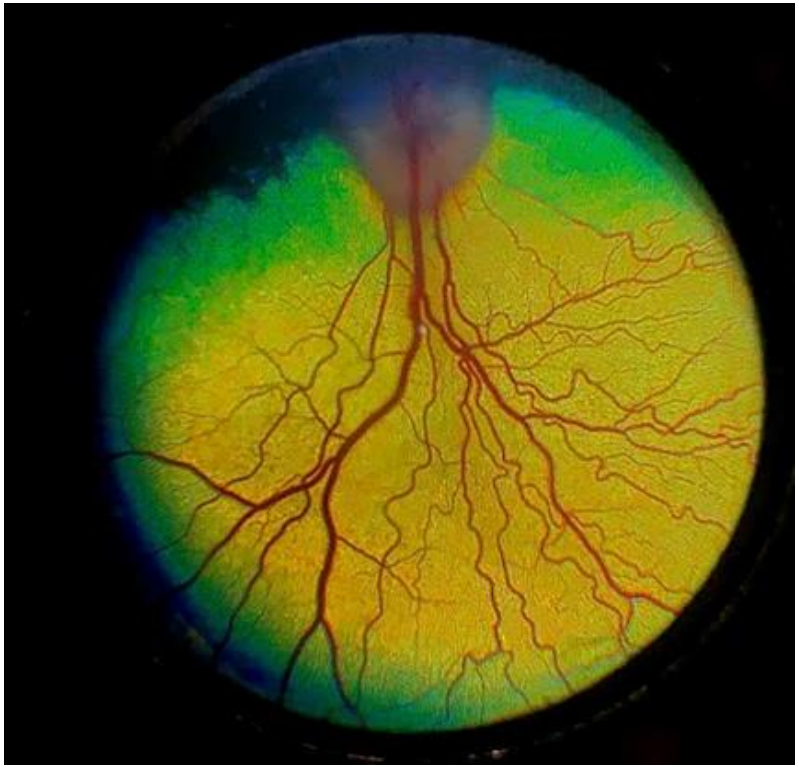
30mm

5.5mm

Your phone as a fundus camera



Direct fundoscopy - iPhone 6plus indirect fundoscopy



iPhone XS max & volk panretinal 2.2

What’s the best phone for imaging the eye?

“The one in your pocket” - any phone can be used to obtain helpful clinical images with a little help however…….

iPhone X - best for fundus

iPhone 7Plus - best for macro photography

“But any phone with any camera can take amazing images. with a little ingenuity, and a light source and a macro lens”

iPhone X

iphone 7plus

Getting started - phoneoscopy for beginners

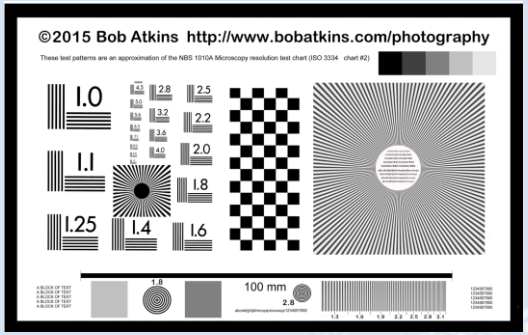
Practical session 1: the basics

Key skills

- Learn how to alter focus
- Learn how close your camera can focus (MFD)
- Learn how to turn your phone light on whilst taking images
- Experiment with “distant direct phoneoscopy”

Equipment needed

- Smart phone
- Camera app which allows light to be in “torch mode” whilst capturing images
- Eye model set up in “anterior segment” mode. (1) lid able to hold slides (2) retinal image in slot at bottom of model.



Focusing

How close can you get?

Know how to focus

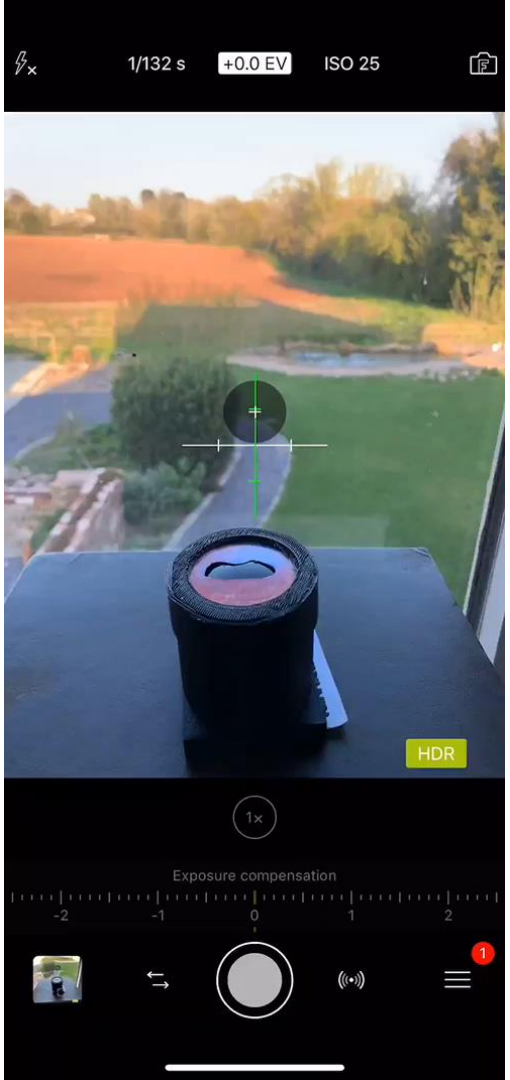
Calculate your minimum focal distance (MFD)

Tips:

- Focus on a sharp edge
- Use digital zoom to check focus

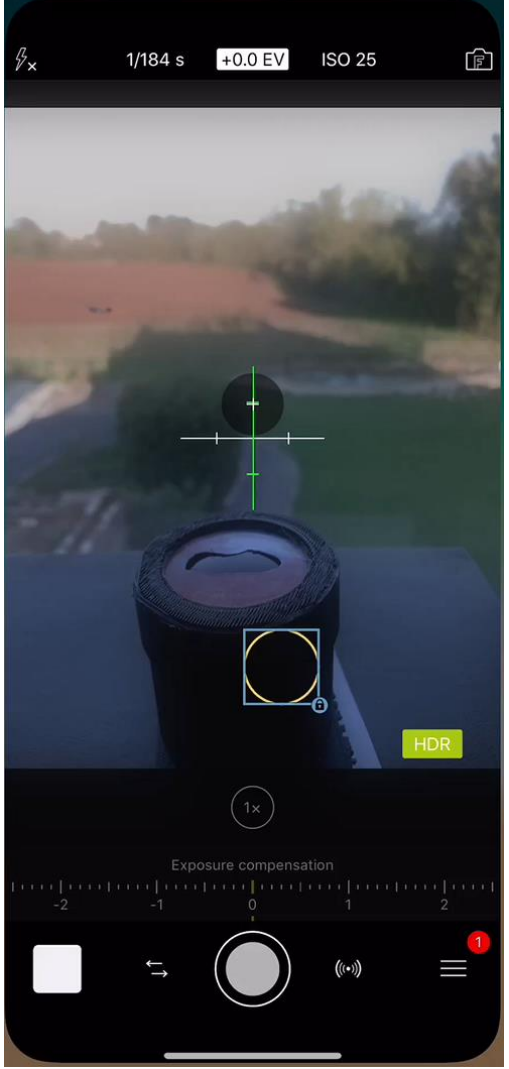
Focus

Full auto



Focus

Tap to focus

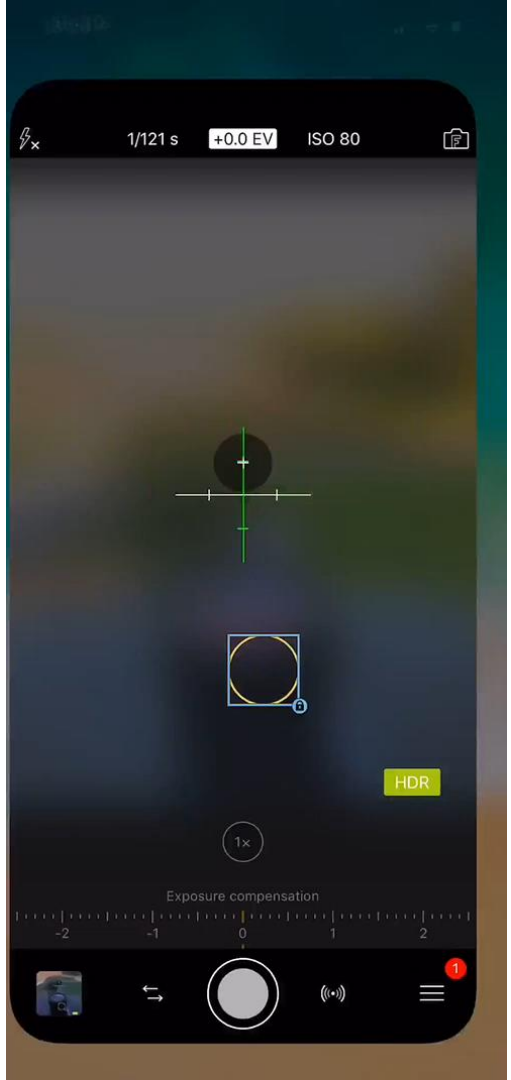


Focus

Manual focus

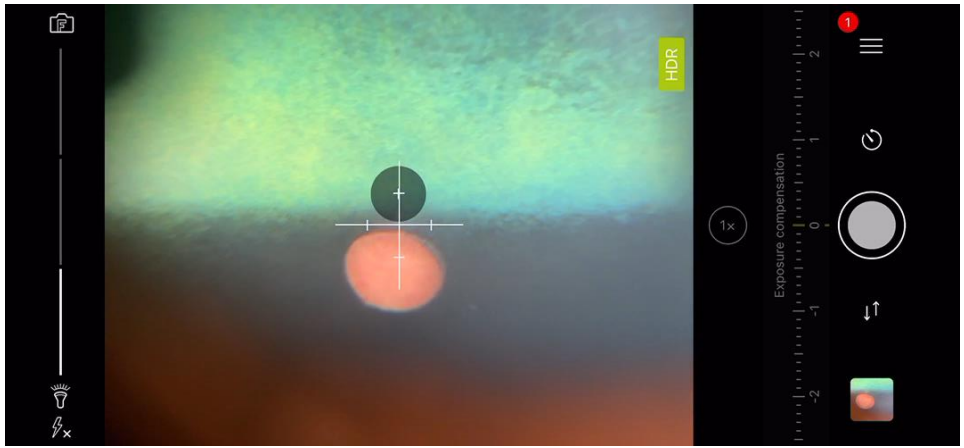
Focus

Manual focus



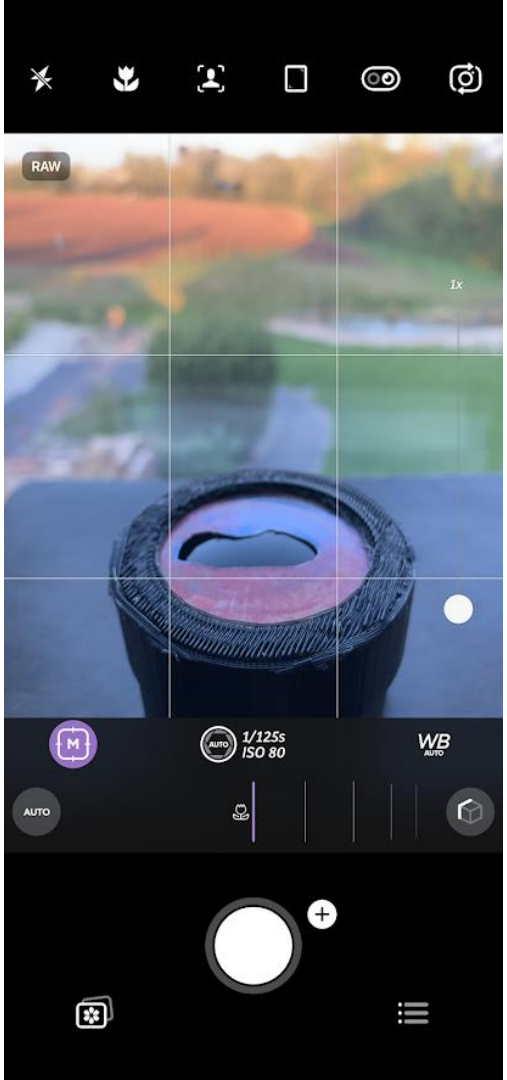
Focusing

Manual focus



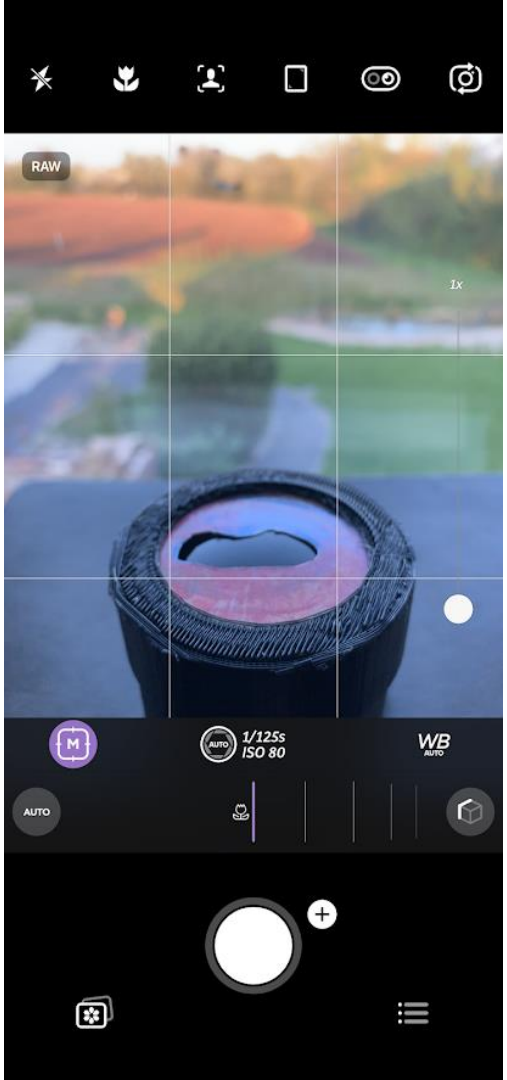
Focusing

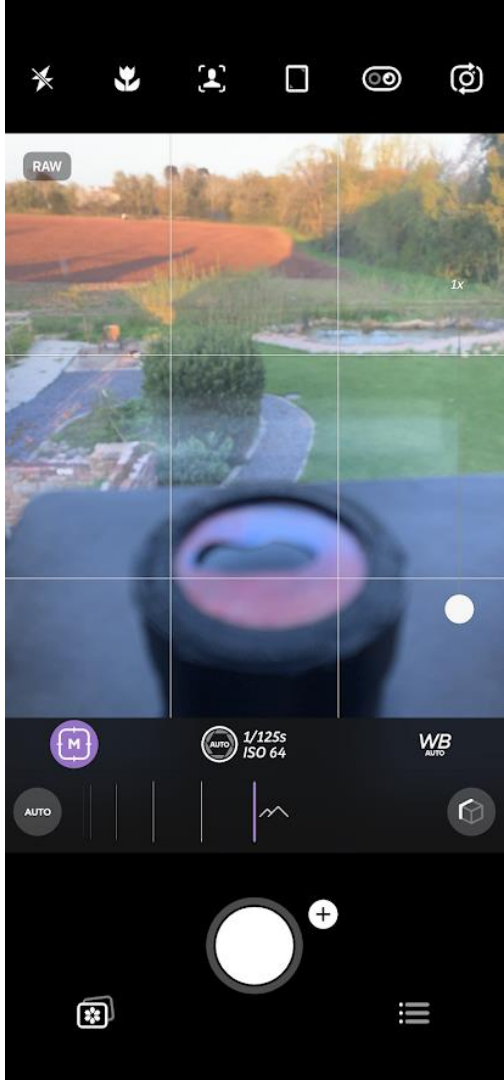
Manual focus (Camera +)



Focus

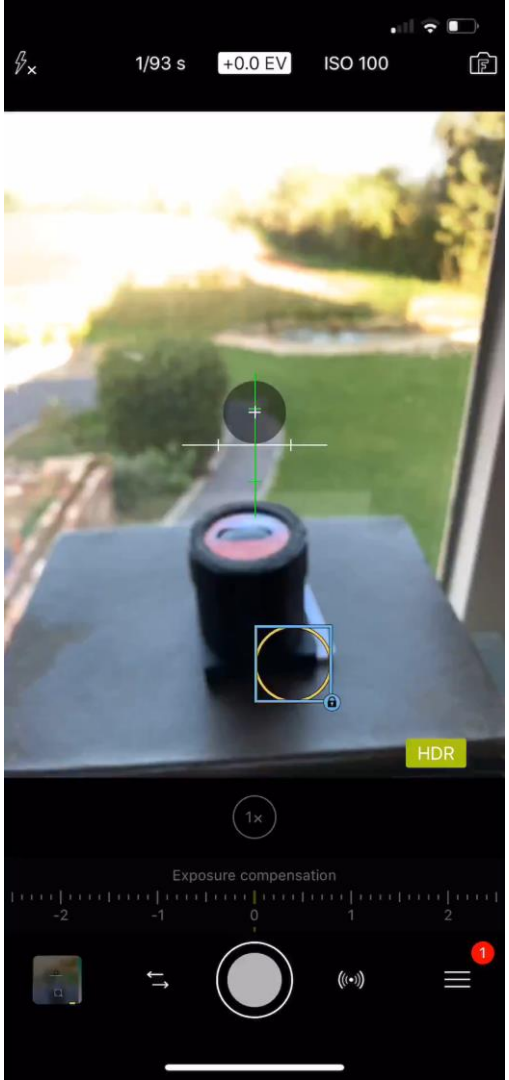
Manual focus (Camera +)





Focus

Fixed focus



Focusing

Locking focus

Focus

macro mode

“Distant direct phoneoscopy (DDP)”

Distant direct phoneoscopy

- *Ophthalmoscope on zero*
- *Light source as close to visual axis as possible*
- ***Phone camera with light on***

Use as a “pupilometer” : assess pupil size, symmetry, shape and response to light.

Assess tapetal reflectivity & symmetry.

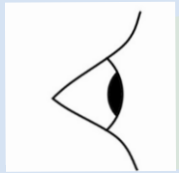
Assess opacities in the visual axis

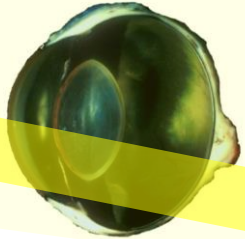
Assess opacities outside the visual axis

Localisation of opacities using parallax

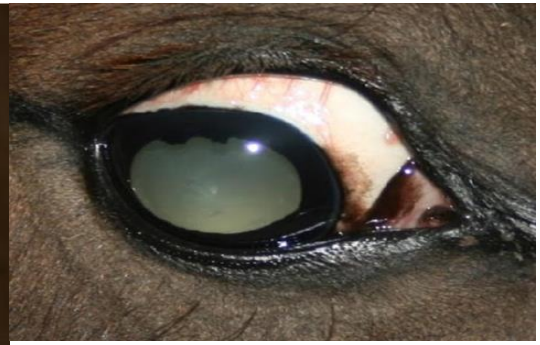
Localisation of opacities using oblique illumination “the search light technique”.

Pupilometer





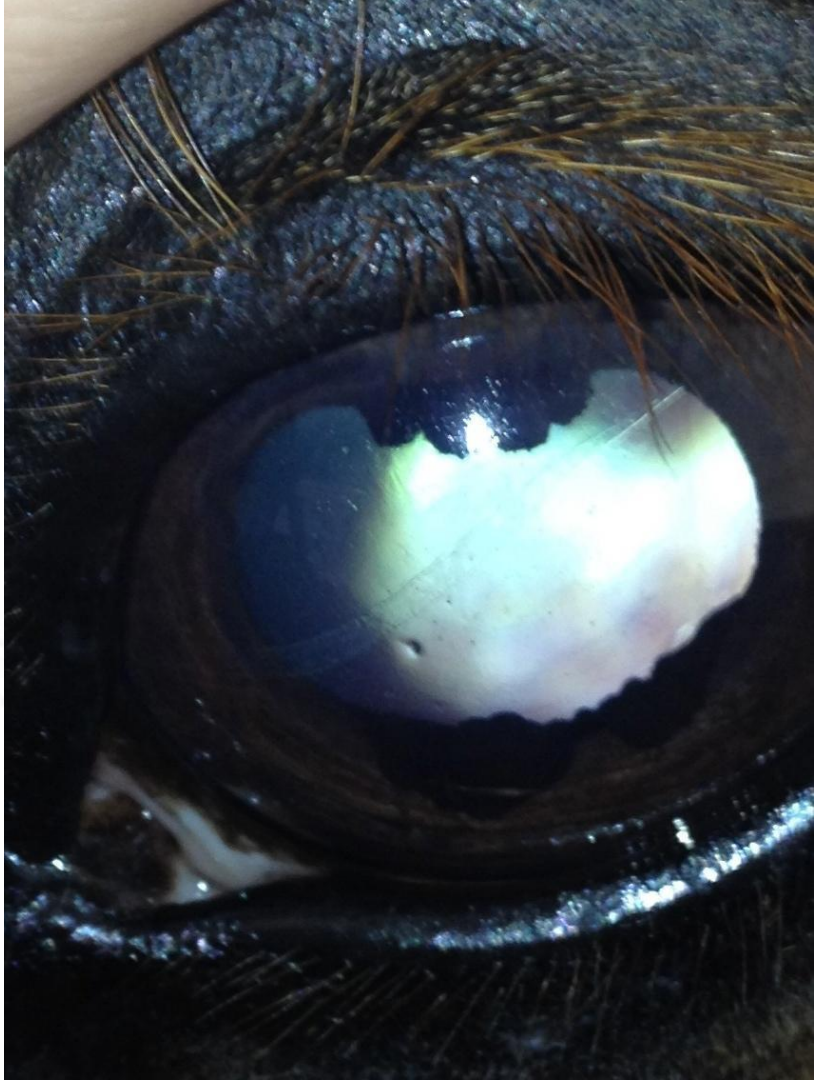
Compare tapetal reflection



Distant Direct Phoneoscopy

Assess refractive changes in the visual axis:

Linear keratopathy



Distant Direct Phoneoscopy

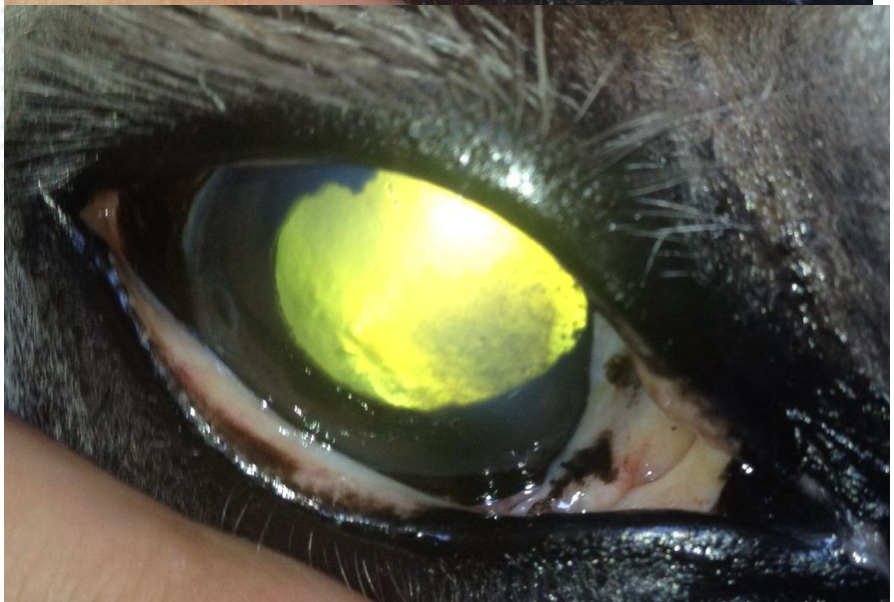
Assess opacities & refractive changes in the visual axis:

Superficial keratectomy

Distant Direct Phoneoscopy

Assess opacities in the visual axis:

Corneal oedema
Keratic precipitates

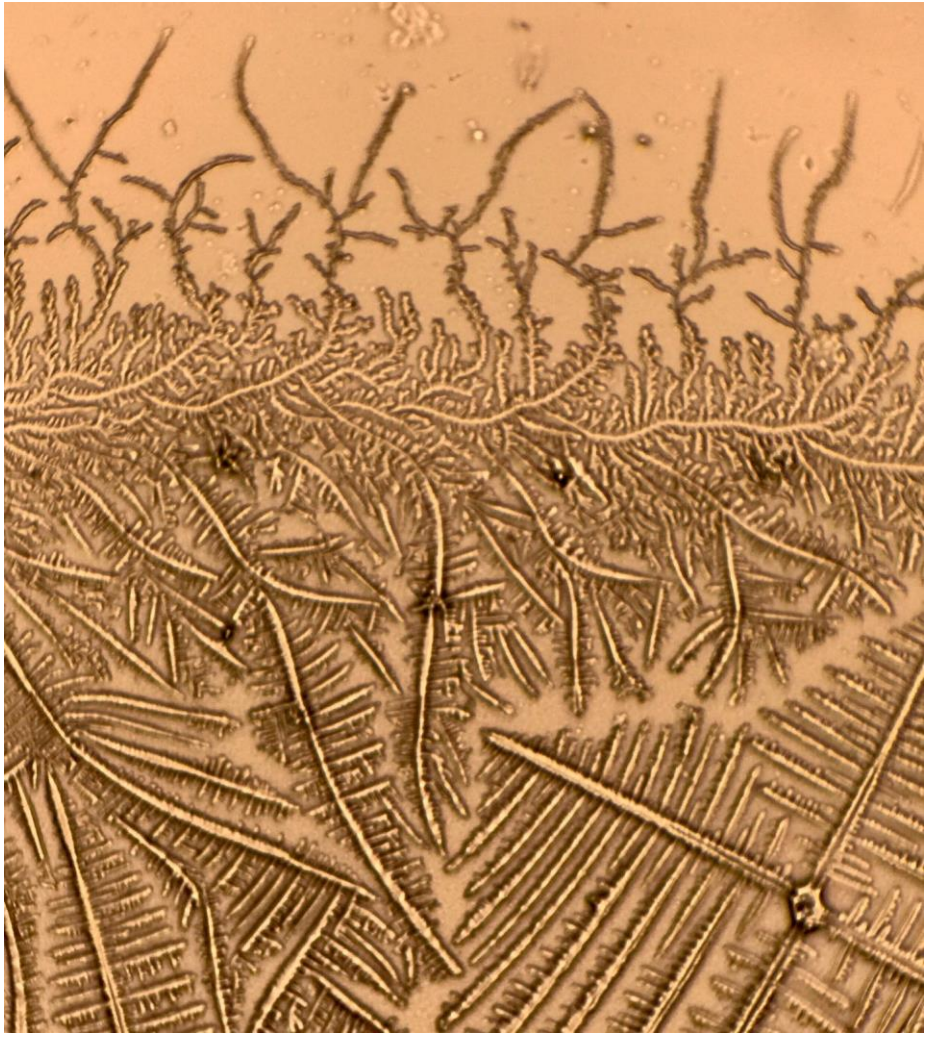


Distant Direct Phoneoscopy

Assess opacities outside the visual axis

- Vitreal strands
- Iris rest

Don’t forget your microscope



Practical session 1

Smart phone photography basics & mimicking the Distant Direct technique with your smart phone

Task 1: Learn how to focus

Focus on table , focus on furthest point in room.

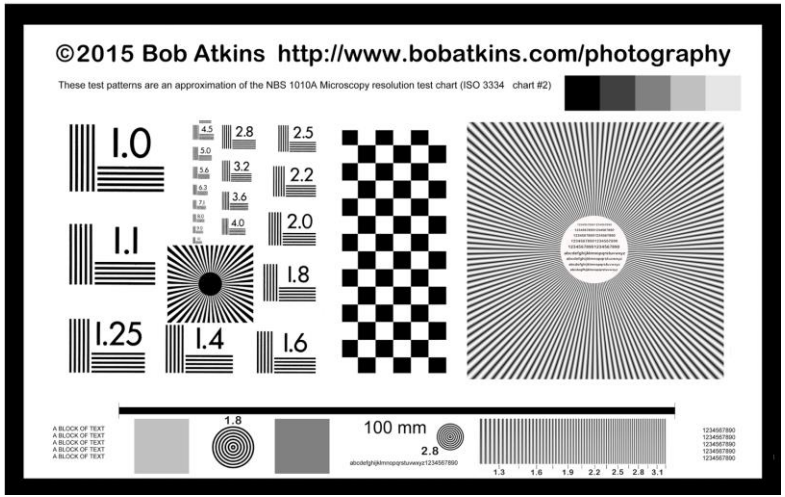
Tips:

Autofocus by tapping on the screen

Manual focus (where available) - select macro for closest focus point and infinity (mountains) for furthest focal point.

Task 2: Identify your smart phones minimum focal distance (MFD)

Using the focus chart below work out the closest distance you can clearly focus and using your hand as a measure record it on the ruler. Remember your MFD it’s the key to successful images.



Task 3: Task Whole head photography

With a partner take 2 images of their face from the front:

- one with no flash
- one with the phone in “torch mode” (the LED turned on continuously).

Tips:

- focus on eyes
- “patient” looking towards you

Look for:

- Asymmetry
- Corneal reflection (on the unlit image)
- Red reflex (anisocoria, opacities in visual axis on the illuminated image)

“Distant direct phoneoscopy (DDP)”

Step 1: Light on

Step 2: Phone at arms length (30cm+) from eye to obtain tapetal reflection – use digital zoom so both pupils easily visible

Step 3: Assess (and record) PLR by moving light away from pupil

Step 4: Use digital zoom to get pupil to fill your screen.

Step 5: Change angle of view to assess tapetal reflection outside of the visual axis (superior, inferior, nasal and temporal)

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Task 4: “Whole eye” photography

Using first your model eye and then your partner’s eye, record an image of the eye which fills the screen (use digital zoom), with and without the light turned on continuously.

Tips:

- focus on lateral canthus of your partner and on the model lid if struggling to get focus
- try forcing your phone to focus at it’s MFD (using the macro setting of available or manual focus)
- ensure partner directs gaze at you
- ensure perpendicular to the cornea of your model
- to reduce miosis and increase the size of your red reflex hold phone at arm’s length and use digital zoom.

Look for:

- Asymmetry
- Corneal reflection (in the unlit images particularly)
- Red reflex (anisocoria, opacities in visual axis)

“Distant direct phoneoscopy (DDP)”

Step 1: Light on

Step 2: Phone at arms length from eye to obtain tapetal reflection – use digital zoom so both pupils easily visible

Step 3: Assess (and record) PLR by moving light away from pupil

Step 4: Use digital zoom to get pupil to fill your screen.

Step 5: Change angle of view to assess tapetal reflection outside of the visual axis (superior, inferior, nasal and temporal)

“Close distant direct phoneoscopy (cDDP)”

Step 4: Move Phone close to eye, aim to position so the phone is as close to the cornea as it can get and still focus (fixing the focus at the MFD using either the “macro” setting or manually will make this easier). Ensure not using digital zoom at this stage.

Step 5: Move phone slowly forward moving the focal point through the visual axis.

Step 6: Repeat step 5 assessing tapetal reflection outside the visual axis

Step 7: If identify lesions - use digital zoom to enlarge, examine and ensure correct focus before record.